



Vol. 24, No. 5

MAY 1955

Pages 141-182

ZEISS ELECTRON MICROSCOPE Type EM 8

Some Salient Features:

1. Electrostatic Lenses free from distortion, uninfluenced by changes in voltage.
2. Objective Lens with stigmator eliminating astigmatism; Limit of resolution 20 Å.
3. Telefocus Cathode eliminates adjustments of condenser.
4. Electron-optical magnification in 8 steps 200 to 16,000 X; Viewing Microscope magnifying electron-optical image. Limiting Magnification 320,000 times.
5. Stereoscopic Device, Dark Field Equipment; Diffraction Equipment.
6. Oil Diffusion Pump requiring no liquid-air trap.
7. Magazine for 24 photographic plates 6×9 cm.
8. Airlocks for changing specimens and removing plates; Time for changing specimens 30 secs.; for removing plates 10 secs.
9. High-frequency Generator inside microscope stand, adjustable upto 60 kV. Intermediate Accelerator for 100 kV.
10. High Performance. Specially suitable for Biological and Medical Research.

Sole Agents :

ADAIR, DUTT & CO. (India), LTD.
MADRAS CALCUTTA NEW DELHI BOMBAY

A new development...



SUPER- SHAKER



The shaking effect is quite remarkable and is achieved by the novel mechanism which imparts a three-dimensional movement to bottles not unlike that obtained by hand, but far more vigorous. The movement can be described as violent reciprocation accompanied by a twisting up and down motion and the contents of bottles are shaken very thoroughly. The machine runs extremely quietly and is very substantially built.

Please apply for Publication No. 561

Accredited Agents

MARTIN & HARRIS LTD.

(Scientific Department)

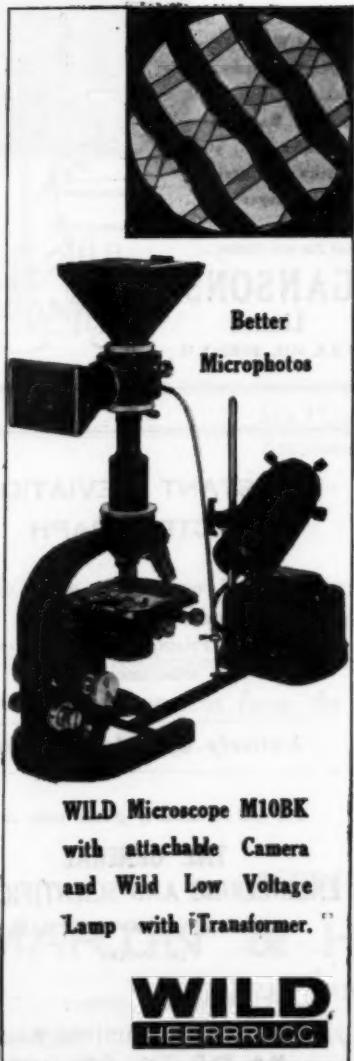
SAVOY CHAMBERS

WALLACE STREET

BOMBAY 1

'WILD'

HEERBRUGG



WILD Microscope M10BK
with attachable Camera
and Wild Low Voltage
Lamp with Transformer.

WILD
HEERBRUGG

The Microscope of Choice for

all Exacting Work !

- * High precision achieved by modern equipments
- * Outstanding optical performance
- * Extensive interchangeability of parts
- * Extreme convenience of operation
- * Modern overall design

RAJ-DER-KAR & CO.
COMMISSARIAT BUILDING, HORNBY ROAD
BOMBAY-1

Telephone: 27304

Telegram: TECHLAB



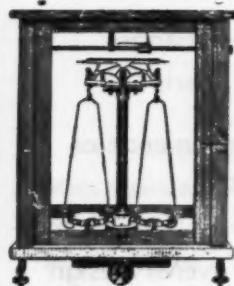
INDEX

BEAKERS AND FLASKS
ARE MADE OF SUCH THICKNESS
JUST TO STAND MECHANICAL AND
PHYSICAL STRAIN. THEY ARE
ALSO HEAT RESISTANT AS THE
COEFFICIENT OF EXPANSION IS
ONLY 3.4×10^{-6} . THUS THEY ARE.
PARTICULARLY SUITABLE FOR
RESPONSIBLE LABORATORY
WORK.

Sole Distributors :

GHARPURE & CO

P-36, Royal Exchange Place Extn.
Calcutta I



KEROY

Short Beam Analytical Balance

No. K1

A Really Dependable Balance for Degree
Classes and Research Laboratories

Sensitiveness .. 1/10th mg.

Capacity .. 200 gm.

Price: Rs. 330/-

Catalogue on Request

Manufactured by:

Keroy Ltd.

BANARAS CANTT. :: CALCUTTA 10



Latest Developments

GAS PLANTS

now working on cheaper oil
than PETROL. Reduce costs
still lower.

OTHER

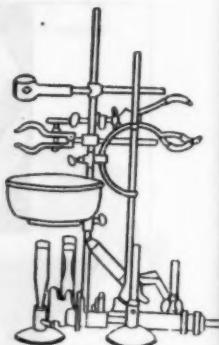
SPECIALITIES

Burners, Clamps, Baths
Gas and Water Taps
Ovens, Incubators
Shakers, Stands, Stills
Stirrers, Research
Apparatus, etc., etc.
Repairs and Servicing
of Microscopes and
Instruments

Ask for new Catalog.

GANSONS
Limited

P.O.B. 5576, BOMBAY 14



CONSTANT DEVIATION SPECTROGRAPH

with Wave Length Drum and Camera,
with Precision Micrometer Slit with
Comparison Prism and with telescope
attachment

Entirely Our Manufacture

For full particulars, please write to :

**THE GENERAL
ENGINEERING AND SCIENTIFIC CO.**

WALTAIR, VISAKHAPATNAM-3
(S. INDIA)

Technical Adviser :

Dr. I. RAMAKRISHNA RAO
M.A., Ph.D. (Cal.), D.Sc. (Lond.)

WARD'S BIO-PLASTIC SPECIMENS



Pz-6310 •• Turtle
Young specimen, entire



Pz-5950 •• Sea Horse
Specimen about 2" long

Plastic embedded specimens of WARD'S Natural Science Establishment Inc., Rochester, U.S.A., stimulate student interest and provide in the most convenient form the actual specimens so necessary in the teaching of Biology.

ACCREDITED AGENTS

MARTIN & HARRIS LIMITED
(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

Mixing and blending . . .



is a simple and efficient process with Pascall Mixers, available in six sizes with trough capacities from 1 to 20 cu. ft.

Pascall Mixers have many features of interest such as the removable agitators to facilitate cleaning, the full-bore discharge outlet with a lever operated sliding gate, and the safety devices which prevent the mixer being set in motion whilst the top cover is open. Motorised models are fitted with motors driving through an integral gear box coupled direct to the centre shaft.

PASCALL

GIDWANI & CO., POST BOX No. 1778, BOMBAY 1



RESISTANCE BOXES



SINGLE AND MULTIPLE DIALS

TOTALLY ENCLOSED

SELF-CLEANING BRUSHES

OF IMPROVED DESIGN

FOR VERY LOW CONTACT-RESISTANCE
MINALPHA COILS—ACCURACY 0·1%

THE STANDARD SCIENTIFIC
INSTRUMENTS CO.

115, BRODIES ROAD,

MADRAS 28

Telephone: 62761 Grams: 'LABFURNISH'

Laboratory Furnishers

DHUN MANSION, VINCENT ROAD, DADAR
BOMBAY 14

We offer from ready stock:

- QUICKFIT AND QUARTZ
Interchangeable Ground Glass
Equipment
- Orsat-Lunge Gas Analysis Apparatus
Superior German Make
- Edwards & Cenco, Vacuum and
Pressure Pumps

Plus everything you need for your Laboratory:
APPARATUS, GLASSWARE, METALWARE
INSTRUMENTS, etc., etc.

Branch Office:
MOTILAL MANSION, KAPASIA BAZAR
AHMEDABAD 2

Indian skill can make

Analytical Reagent Chemicals of the same High Standards of Purity
as those made by German, British and American Technical Skill

Very Reliable Indigenous Substitutes of Guaranteed
Analytical Reagents may be found in

BASYNTH BRAND

Acid Sulphuric	..	..	..	sp. gr. 1·84
Acid Hydrochloric, Fuming	..	..	..	" 1·19
Acid Hydrochloric	..	..	..	" 1·18
Acid Nitric	..	..	..	" 1·42
Ammonium Hydroxide	..	..	..	" 0·90

And many other items all made in India by

BASIC & SYNTHETIC CHEMICALS LTD.
P.O. JADAVPUR COLLEGE, CALCUTTA 32

Use Swadeshi

And Help to Keep Employed Indian Technical Skill in Industries



TEMPO

Electrode Boiler

(Patent Pending)

- * An automatic handy device for steam distillation in laboratories.
- * Steam at a constant pressure of 9-10" W.G.
- * Works on 230 V. A.C.

For further particulars write to :

TEMPO INDUSTRIAL CORPORATION

1st Floor, Devkaran Mansion

PRINCESS STREET : : BOMBAY 2

BHARATIYA BHOOTATWA KI BHOOMIKA

(Hindi translation of Dr. M. S. Krishnan's
Introduction to the Geology of India)

by

SHRIMATHI AKHILADESHWARI

with a foreword by

SHRI SRI PRAKASA

Governor of Madras

This translation in easy and elegant Hindi will fill the need for an authoritative text book on Indian Geology in the National language. A section on explanations of technical terms in Hindi, and a Glossary, are special features of this Hindi Edition.

Printed on superior paper in fine,
clear types with 13 original
illustrations

250 pages, double demy 8-vo. Price Rs. 8/-

Available at :

HIGGINBOTHAMS LTD.
MOUNT ROAD, MADRAS 2

INDIAN CENTRAL ARECANUT COMMITTEE

Applications are invited from Indian Nationals and persons migrated from Pakistan with intention to permanently settle down in India or subjects of Nepal or Sikkim, Portuguese or former French Possessions in India, for the undermentioned posts for the Central ArecaNut Research Station, Vittal, South Kanara District in Madras State, under the Indian Central ArecaNut Committee. The appointments will be made on a temporary basis in the first instance and are likely to be made permanent. The posts are non-pensionable, but the employees of the Indian Central ArecaNut Committee are eligible to subscribe to the Contributory Provident Fund of the Committee. The applications of employed persons will be considered only if they are submitted through proper channel.

1. ARECANUT SPECIALIST

Pay Rs. 600-40-1,000-1,050-50-1,100-1,100-1,150.

Dearness allowance at Central Government rates.

Age: Not exceeding 45 but relaxable in exceptional cases.

Qualifications: A degree in Agriculture, Post-Graduate Degree in Agricultural Botany or Horticulture from an Indian or foreign University. Experience of Research on plantation crops preferably in plant breeding methods for about 10 years. Administrative experience desirable.

2. AGRONOMIST

Pay Rs. 275-25-500-30-800.

Dearness allowance at Central Government rates.

Age: Not exceeding 35, relaxable up to 37 in the case of scheduled castes and tribes.

Qualifications: A degree in Agriculture, Post-Graduate Degree in Agronomy from Indian or foreign University. At least five years' experience of Agronomical Research and thorough knowledge of field experimentation. Managerial experience desirable.

SECRETARY,
Indian Central ArecaNut Committee,
P. B. No. 14,
Kozhikode—1 (CALICUT)
S. India.

COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

Mining Research Station, Dhanbad

Applications are invited for the post of Planning Officer for the Mining Research Station to be established at Dhanbad in the scale of Rs. 600-25-650-35-1,000-EB-50-1,200-100-1,500 plus allowances as admissible to Central Government servants. A higher initial pay may be given to a specially qualified candidate.

Candidates should hold high qualifications in Mining Engineering and Science and should preferably have considerable research experience. Administrative experience will be an additional qualification.

Applications, in duplicate, in the prescribed form (obtainable from the Secretary, CSIR) together with a crossed postal order for Rs. 7/8 (Rs. 1/14 in the case of scheduled castes and scheduled tribes) should reach the Secretary, Council of Scientific and Industrial Research, Old Mill Road, New Delhi, by 9th July 1955.

RS. 2,000

Prize Offered for Instrument Design

The Indian Council of Agricultural Research offers a prize of Rs. 2,000 for the design of a portable instrument for quick determination of moisture in the field.

Full particulars can be had from:

THE SECRETARY
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
AGRICULTURE IV SECTION, MULTISTOREY BUILDING
QUEEN VICTORIA ROAD - - - NEW DELHI

AC-512(1)

CURR. SCI., MAY 1955

Important Announcement

We have the pleasure to announce our appointment as
Exclusive Agents in India for the products of

Messrs. BAIRD & TATLOCK (LONDON) LTD.

The B.T.L. 1954 Catalogues have already been distributed widely in India. A limited number of further catalogues in the following three sections are still available with us for supply against official request:

- (1) General Instruments, Apparatus and Medical Sciences
- (2) General Instruments, Apparatus and Industrial Sciences
- (3) General Instruments, Apparatus, Medical and Industrial Sciences

We are also booking indents for:

**Fine Organic & Inorganic Chemicals
Standard Reagent Chemicals**

- (a) "Analar" Laboratory Chemicals
- (b) "Polaritan" Reagents for Polarographic Analysis
- (c) Micro-Analytical Reagents
- (d) Micro-Analytical Standards

Manufactured by the Well-Known Firm

M/s. HOPKIN & WILLIAMS LTD., LONDON

Catalogues and prices available on request

TOSHNIWAL BROTHERS LIMITED

198, Jamshedji Tata Road
Fort, BOMBAY 1

Phone: 35952. Grams: ANUSANDHAN

9, Blackers Road, Mount Road P.O.
MADRAS 2

Grams: RESEARCH

Current Science

Vol. XXIV]

MAY 1955

[No. 5

	PAGE		PAGE
<i>Albert Einstein—Sir C. V. RAMAN</i>	141	<i>Indian Agricultural Research Institute, New Delhi, 1905-55</i>	150
<i>The Bubble Chamber</i>	142	<i>Letters to the Editor</i>	151
<i>Australian Experiments in Rain-Making</i>	143	<i>Reviews</i>	175
<i>Vivotoxins and Fusariose Wilts in Plants —C. V. SUBRAMANIAN</i>	144	<i>Spanish Wheats—H. SANTAPAU</i>	179
<i>Cesium Atomic Frequency Standard</i>	147	<i>Nutritional Factors and Liver Diseases —G. D. VELIATH</i>	180
<i>Orbitoides faujasi—The First Orbitoid from the Cretaceous Rocks of South India—L. RAMA RAO</i>	148	<i>Dr. D. M. Bose</i>	180
		<i>Science Notes and News</i>	181

ALBERT EINSTEIN

FIFTY years ago, in the year 1905 to be exact, a series of papers appeared in the *Annalen Der Physik* within a few months of each other which profoundly influenced the subsequent development of physical science and indeed created a revolution in our conception of nature and its workings. The author of those epoch-making contributions to science was a young man then 26 years of age who held a position as an examiner of patents and designs in the Federal Patent Office at Berne, in Switzerland. It was not long before the immense importance of the ideas set out in those papers received general recognition and it became evident that a star of the first magnitude had arisen in the firmament of science.

The main facts of Einstein's life may be briefly summarised here. He was born on the 14th March 1879, at Ulm in South Germany but spent his childhood at Munich. In 1894, when his parents migrated to Milan in Italy, Einstein moved to Switzerland where he con-

tinued his further studies, firstly at Aarau and later at Zurich. Following graduation in 1900, he was obliged to seek employment for maintaining himself. In the autumn of 1902, he obtained a position at Berne in Switzerland in the Federal Patent Office where he remained till 1909. While thus employed, he also worked as a candidate for the doctor's degree which he obtained from Zurich in 1905. The recognition gained by his work led to his being called to a professorship at Zurich; for a short period he migrated to Prague and returned again at Zurich in 1912. Finally in 1914, Einstein moved to Berlin as Professor in the Prussian Academy of Sciences and Director of the Institute of Theoretical Physics. In the year 1933 as a consequence of the activities of the Hitler regime, he found himself obliged to resign these positions and accepted a call to a professorship at the Institute for Advanced Study at Princeton, New Jersey, in the United States of America. In the year 1945 he retired from

the latter position but continued to live at Princeton in quiet seclusion till his death on the 18th April of this year.

Einstein's record of scientific research and publication extends over half a century. The period from 1905 to 1915 however witnessed the emergence from his creative brain of those fundamental ideas which transformed the whole complexion of physical science. It is not possible to contemplate the results, at once so profound and so powerfully original, achieved by Einstein in this short period without a feeling of astonishment and admiration. We may permit ourselves to quote here the opening words of the admirable summary of Einstein's scientific work written by Louis de Broglie for the special volume dedicated to Einstein in the "Library of Living Philosophers" published in the year 1949. "For any educated man, whether or not a professional scientist, the name of Albert Einstein calls to mind the intellectual effort and genius which overturned the most traditional notions of physics and culminated in the establishment of the relativity of the notions of space and time, the inertia of energy, and an interpretation of gravitational forces which is in some sort purely geometrical. Therein lies a magnificent achievement comparable to the greatest that may be found in the history of the sciences; comparable, for example, to the achievements of Newton. This alone would have sufficed to assure its author

imperishable fame. But, great as it was, this achievement must not cause us to forget that Albert Einstein also rendered decisive contributions to other important advances in contemporary physics. Even if we were to overlook his no less remarkable work on the Brownian movement, statistical thermodynamics, and equilibrium fluctuations, we could not fail to take note of the tremendous import of his research upon a developing quantum theory and, in particular, his conception of "light quanta" which, reintroducing the corpuscular notion into optics, was to send physicists in search of some kind of synthesis of Fresnel's wave theory of light and the corpuscular theory....."

Within the limits of this article it is not possible to attempt a general survey of the scientific work of Einstein or to review the influence exercised by it on his contemporaries and on the progress of physics which has been enormous. Many impressive tributes have been paid to the greatness of Einstein and his work by illustrious contemporaries. I need therefore add here only a brief acknowledgement of my own personal indebtedness to the inspiration that I have derived from time to time from a study of Einstein's fundamental papers on thermodynamics, light-scattering and quantum theory. I have returned to them again and again in the course of my work and benefited thereby.

C. V. RAMAN.

THE BUBBLE CHAMBER

THE 'bubble chamber', a new device that combines the experimental possibilities of the Wilson cloud chamber with the high mass density available in photographic emulsion techniques, was described at the recent meeting of the American Physical Society in New York. The feasibility of using the bubble formation in a liquid to make the path of ionizing particles visible was first demonstrated by D. A. Glaser of the University of Michigan, and the instrument was further developed by experimentalists at the University of Chicago and at the Radiation Laboratory in Berkeley. At present the device is being used in several laboratories to study high energy nuclear events.

The bubble chamber makes use of the unstable system of a superheated liquid—that is,

liquid hydrogen at a temperature above its boiling point. As soon as ionizing radiation enters the system, gas bubbles are formed and the liquid starts to boil almost immediately. If, however, a picture of the bubble formation is taken a few microseconds after the ionizing event takes place, then the bubbles formed along the path of the ionizing radiation give rise to a visible track. The high density of the liquid, the almost complete absence of undesired tracks owing to the shortness of the time interval during which the chamber is sensitive to ionizing radiation, and the possibility of taking picture in rapid sequence make the bubble chamber an extremely versatile instrument for the study of high energy events.

In the with dr. craft. suitable than rain. The sun determines the clo colder t. At temp chances as 0° C -15° C because ducing. The am creases the am to its thick as proportionate

In the of dry i ggle clou appeared tity of tion to a made up talts to of cloud continue from 25 the suc checks w of ice rally, an were se chosen produced results other th ment w

Exp iodide s to those smaller, to sever is either ice or d that col sary for the

AUSTRALIAN EXPERIMENTS IN RAIN-MAKING

In the period from 1947 to 1951 about one hundred experiments of seeding of clouds with dry ice were made in Australia from aircraft. These experiments showed that given suitable cloud conditions it was tolerably certain that seeding with dry ice would produce rain which would not otherwise have fallen. The suitable cloud conditions are critically determined by the temperature in the top of the cloud. At temperatures of -7°C . and colder there is 100% chance of producing rain. At temperatures between -7°C . and 0°C . the chances of success taper off, tending to zero as 0°C . is approached. At temperatures of -15°C . and lower the results lose significance because of the high probability of clouds producing rain naturally at these temperatures. The amount of rain produced by seeding increases with the thickness of the cloud, while the amount reaching the ground depends on the height of the base of the cloud in relation to its thickness. If the cloud is at least as thick as the height of its base, a considerable proportion of the rain will reach the ground.

In the experiments carried out the amount of dry ice used varied from 10-300 lb. on a single cloud, and the amount of precipitation appeared to increase with the greater quantity of dry ice used. The time for precipitation to appear was usually about 15-20 minutes, made up of about 10 minutes for the ice crystals to grow, and another 1 minute per 800' of cloud depth for them to fall. Rain generally continued from 40-60 minutes, during which from 25-75 points were recorded. In assessing the success of the seeding experiments careful checks were made with radar for the presence of ice crystals that would produce rain naturally, and only clouds where these were absent were selected for seeding. A single cloud unit amongst a group of similar units was then chosen for seeding. If any of the other clouds produced rain during the experiment the results were disregarded, but if no rain fell other than from the seeded cloud the experiment was deemed successful.

Experiments in seeding clouds with silver iodide are similar in purpose and performance to those with dry ice. The quantity used is smaller, varying from a fraction of an ounce to several ounces per cloud. The silver iodide is either ejected from the aircraft with dry ice or dropped on a parachute flare. It is thought that colder cloud-top temperatures are necessary for success than with dry ice, and therefore there are less occasions on which silver

iodide seeding will produce rain that would not have fallen naturally.

Another method of using silver iodide has been tried by releasing it in the form of smoke from burners on the ground to be carried upwards by convection. The only Australian experiment using this method was carried out near Hay, New South Wales, over a period of three months and was inconclusive. It appears that smoke particles of silver iodide lose their effectiveness before they reach the right part of the cloud. Yet some development of this method appears to offer possibilities as an economic means of large-scale rain-making.

Rain produced by coalescence of water droplets in clouds which do not reach to freezing heights occurs almost entirely in coastal and maritime areas. A good deal of the rain in Eastern Australia is due to this process. The necessary conditions for natural rain of this type are that the water content of the cloud should be relatively high, that there should be up-draughts of air of at least 1-2' per second persisting for at least 30 minutes, and there must be a wide range of size of the water droplets, which is helped by the presence of hygroscopic nuclei. The up-draughts of air then lift the small drops faster than the large drops, which grow even larger by collision with smaller drops. If the first two conditions exist, but all the water droplets are of similar size, no rain will fall.

In these circumstances, seeding the base of the cloud with large water drops or some form of condensation nuclei will initiate the growth of water droplets at the expense of others to a size large enough to fall as rain. Experiments with aircraft flying about 1,000' above the base of these types of clouds and spraying water at the rate of 100 lb. per mile have produced rain, but only from clouds over 5,000' thick.

It is clear that these successful methods used in rain-making experiments are too expensive for use on a practical scale. The major cost is not in the materials, but in the use of aircraft. Fairly large and robust aircraft are necessary to reach heights well above freezing level, usually ranging upwards from about 8,000', or to penetrate lower turbulent clouds. Actual flying time might not be too costly, but the necessity of having adequate aircraft standing ready to catch the right cloud formations at the right moment makes it an uneconomic proposition on a practical scale. The emphasis now lies on finding cheaper methods.

VIVOTOXINS AND FUSARIOSE WILTS IN PLANTS

C. V. SUBRAMANIAN

University Botany Laboratory, Madras-5

DURING recent years considerable attention has been paid to the study of the mechanism of vascular wilt diseases of plants, especially those caused by Fusaria. One of the earliest to postulate a mechanism was Erwin Smith¹ who, in 1899, suggested plugging of the tracheæ in the stem of the infected plant by the hyphae of the pathogen and the consequent impediment to the upward flow of solutes. Indeed, this is implied in the terms, "vascular wilts", "tracheomycoses", "hadromyces", etc., which are in current use for these diseases, and they do convey a correct picture of the essential disease syndrome and the host-parasite relationship. Critical evidence to support the vessel-blocking hypothesis was, however, not presented by Smith or those who followed him and, with the publication, in 1913, of Hutchinson's² paper on a bacterial disease of tobacco in India the possible mechanism of which was explained as a case of toxin production, the new theory gained ground, and for well over forty years evidence claimed to be in support of Hutchinson's toxin theory of plant wilts accumulated in the hands of numerous workers. It is scarcely possible, in this brief note, to review all the investigations, but it would suffice to mention here that the method employed in most of these studies was to grow the pathogen in a standard synthetic medium (e.g., Richard's) for varying periods of time and then test out the effect of the culture filtrates on cut shoots of different plant species. An improvement over this method sometimes used was the dialysis of the culture filtrate to remove from it inorganic ions which may themselves be toxic to test plants. Not infrequently, instead of the culture filtrates, the fungal mats themselves were ground up and the effect of extracts, aqueous or otherwise, of the macerated hyphae on cut shoots was studied. Such studies suggested the possibility of the occurrence of (1) toxins excreted by the pathogens into the media in which they were grown (*exotoxins*), and (2) toxins produced within the hyphal cells of the pathogens themselves (*endotoxins*). The bulk of the data available are on exotoxins and opinions regarding the exact nature of these are varied. They have been stated to be enzymes, alkaloids, colloidal and crystalloidal substances, inorganic salts like nitrates, organic acids, amines, ammonia, polypeptides, etc. Endo-

toxins have received comparatively little attention and they have been suggested mostly to be of an enzymatic nature. Little thought has been given to the exact *modus operandi* of these endo-cellular enzymes of the pathogens. The evidence brought forward in most cases in support of the toxin theory of vascular diseases has been one where culture filtrates or extracts of fungal mats of the pathogenic Fusaria were tested for their effects on cut shoots and production of symptoms closely simulating those on plants naturally infected by the pathogens were followed and confirmed. In each case, sufficient precautions were taken, using suitable methods, to exclude the living cells of the pathogens from the filtrates as well as the hyphal extracts. In certain cases, complicity in wilt production was ascribed to certain definite substances and, as positive proof for the conclusion, the toxicity of these substances to cut shoots of plants was cited, although little evidence was presented to indicate that these substances are produced by the pathogens themselves. It would be unscientific to postulate any mechanism for wilt diseases on the basis of such observations since the same disease syndrome in plants may be brought about by a variety of causal agents and similarity of symptoms would be no indication of the nature of the causal agent. In studies on culture filtrates and extracts of fungal mats mentioned above, the *in vivo* physiological changes initiated in the host (cut shoot) tissues were explained on the basis of a poisoning of the living tissues leading to death, an injury to the semipermeability of the plasma membrane and the consequent impairment of the osmotic prerequisites for turgor, or an increased transpiration rate in the diseased state. For the disease syndrome which is a sequence of this process, the term "toxicogenic wilting" has been suggested which is, therefore, indicative of the mechanism involved as postulated by these workers.³

There are, however, those who believe in Erwin Smith's hypothesis of vessel-blocking. There has been a search for a something that would explain fully the blocking effect, apart from the often scanty hyphal ramifications in the vascular system of infected plants originally mentioned to support the theory. This is now claimed to be either some homogeneous hyaline material in the vessels of infected

No
plants
patho
hydro
again
of cel
cellul
terase

It
knowl
the o
the ev
be cri
cultur
on cu
more
in viv
host-p
same a
toxin
the in
living
root-in
a simp
the so
suitab
sent in
metabo
possibl
toxins
denied,
remain
are th
selectiv
molecu
produ
systems
root m
toxin-in
if thi
for an
entry
toxins
of even
do aw
absorb
affected
of path
ledge o
these f
obvious
ing of
more r
lities i
their c

plants,⁴ or polysaccharides produced by the pathogen,⁵ or conjugated phenols arising from hydrolysis of β -glucosidases in the host,⁶ or again products resulting from the maceration of cells in the xylem due to the action of exo-cellular pectic enzymes like pectin methylesterase.⁷

It is difficult, in the present state of our knowledge, to subscribe categorically to one or the other of these views. On the other hand, the evidence in favour of these hypotheses could be critically discussed. *In vitro* studies using culture filtrates of the Fusaria and their effects on cut shoots are of limited value, since it is more than probable that what happens under *in vivo* conditions in a living and complex host-parasite relationship would not be the same as what would take place in a cut shoot-toxin combination. We have to consider here the *in vivo* changes following infection of a living plant with its own root system by a root-infecting pathogen. The question is not a simple one of the pathogen being present in the soil and producing toxic metabolites from suitable organic and inorganic substrates present in the soil and the movement of these metabolites into the host plants. Whilst the possibility of production of antibiotics and toxins in soils by pathogenic fungi cannot be denied, their rôle in plant disease production remains to be established, and the indications are that root systems of living plants may not selectively absorb fungal metabolites of high molecular weights, even though they may be produced in sufficient quantity in infested soils. To what extent toxic fungal metabolites produced in soils could act directly on the effective absorptive surface of the living root systems and damage them, or again, whether root membranes would be without effect in toxin-induced wilting, is not clear. However, if this happens, it should not then be difficult for any saprophytic micro-organism to gain entry into the host and elaborate its own toxins within the host tissues. Such a sequence of events is highly improbable since it would do away entirely with the vital process of absorption by the root systems of plants so affected on the one hand, and the phenomenon of pathogenesis on the other. Fuller knowledge of the rate of penetration of many of these fungal metabolites into living cells is obviously essential for a proper understanding of the physiology of these wilts. Much more remains to be known about their solubilities in the cell membranes of the host roots, their capacity for chemical reaction with the

membranes, their adsorption by colloidal components of the membranes, the electrical charge on the membranes (as to kind and intensity), the kind and magnitude of electrical charges on the ions or molecules of the fungal metabolites themselves, the electrical potential across the membrane, the structure of the entering particle with particular reference to the presence of polar and non-polar groups, the size of the entering particle, the condition of the membranes as to the degree of hydration and the presence of other ions both outside and inside the absorbing cell of the host root system. The question of toxic metabolites produced in soils interfering with root respiration and retarding ion accumulation by the host plants should also be considered. It would appear that at present there is little evidence to indicate any visible damage to root systems in the case of the typical vascular wilts caused by Fusaria and the possibility of direct host invasion and damage by toxic metabolites produced in soils may be considered remote. On the other hand, there is some evidence to indicate that pathogenic Fusaria would produce substances stimulating rooting in cut shoots of plants⁸⁻¹⁰ and, may be, in the case of rooted plants the same stimulating effect may come into play. Pathogenesis, then, becomes the essential prerequisite of disease and it follows that an intensive study of the host-parasite relationship is obviously important in understanding the mechanism of the vascular Fusariose wilts.

Much of the work on the *in vitro* toxic metabolites of pathogenic Fusaria has been carried out, as mentioned already, on cut shoots of plants, and Young and Bennett¹¹ were perhaps the earliest to state that these toxins were non-specific in their action on different host plants. Working with *Fusarium oxysporum* isolated from potato plants, they showed that the culture filtrate of this pathogen was equally toxic not only to potato, but also to tomato and celery. This non-specificity of toxic metabolites to cut shoots of plants has since been confirmed by numerous workers in the case of many species of Fusaria and a diversity of host plants. Another important finding is the fact that such toxic metabolites would be produced not only by pathogenic Fusaria, but also by non-pathogenic strains of Fusaria, and even by innocuous saprophytic moulds such as *Penicillium expansum* and *Aspergillus niger*. This again has received confirmation from many workers. It would appear, therefore, that almost any fungus may produce in culture

metabolites which would be toxic and non-specific to cut shoots of plants. A further criticism is that results obtained from pathogenicity trials and toxicogenicity tests do not run parallel. For instance, culture filtrates of non-pathogenic strains may be very toxic but conversely filtrates of pathogenic strains may be only weakly toxic or not at all. Moreover, results obtained with cut shoots would have to be viewed with caution since they cannot reliably be applied to the case of rooted plants. In one case there would be a passive non-selective movement of the metabolite, whereas in the other one would expect a selective and regulated uptake of the metabolite. That this is, indeed, the case is shown by the recent work of Winstead and Walker¹² on several Fusaria with special reference to their pathogenicity on different hosts and the toxicogenicity of their culture filtrates and hyphal extracts to the various host plants grown on sand culture. The experimental findings of Winstead and Walker indicate that toxicogenicity tests when applied to rooted plants give the same results as pathogenicity tests. Thus, positive toxicogenicity and pathogenicity in the case of *Fusarium oxysporum* f. *conglutinans* was recorded only on its own host, i.e., a susceptible variety of cabbage, but not on several other hosts and resistant varieties of cabbage studied. Similar results were obtained with other Fusaria. It would, therefore, be futile to hope that the real answer to the question of the mechanism of these wilts would come from detailed studies on the culture filtrates of these Fusaria grown on synthetic media and their effects on cut shoots. On the other hand, in all experimental work rooted plants should be used and intensive studies should be made on the lines of the excellent work of Gottlieb¹³ who has shown that a toxic metabolite could be detected in the tracheal sap of rooted tomato plants infected by *F. bulbigenum* v. *lycopersici*. There is thus evidence for the production of toxins *in vivo* within plants infected by Fusaria and such substances produced *in vivo* within the host tissues would well fit Dimond and Waggoner's¹⁴ definition of vivotoxins.

Granting, then, that vivotoxins could be produced by vascular fungal pathogens within the host tissues, it remains to be considered how they would affect the host. Our knowledge of this aspect is again limited and can be summarised by stating that fungal metabolites produced *in vivo* within the host may contribute not only to impede the upward flow

of water and solutes through the tracheae, but may also impair the osmotic prerequisites essential for turgor and may initiate several other physiological changes within the host. For instance, alteration of the permeability of the host cells by toxic metabolites has been envisaged by some workers. Several chemical mechanisms have been postulated: of these, may be mentioned vascular discoloration and occlusion as a product of enzymic action by the pathogens; vivotoxins behaving as competitive inhibitors as, for instance, in the case of the wildfire toxin where competitive inhibition of methionine utilization has been established; and inactivation of enzymes in a non-competitive manner as shown by the results obtained with lycomarasmin which acts as an antimetabolite for the growth factor streponerin.¹⁴

It must be emphasised, however, that a variety of metabolic products are usually produced by Fusaria under *in vitro* conditions, and these include, besides the toxic metabolites discussed already, even growth factors.⁸⁻¹⁰ These growth factors have been shown in this Department to have thiamine replacement value and would even stimulate rooting of cut shoots of plants. Just as is the case with the toxic metabolites, these growth factors are produced, with a few exceptions, by several pathogenic and non-pathogenic strains of Fusaria so far tested¹⁰ and even by fungi belonging to other genera.¹⁵ They are, moreover, non-specific in their effects on cut shoots of different plants. It would appear, however, that the ability to produce such growth factors is not as common amongst the fungi as their ability to produce toxic metabolites, since they do not appear to be produced by fungi like *Aspergillus niger*.¹⁵ Nevertheless, in view of the fact that such growth factors are fairly commonly produced *in vitro* by several vascular wilt Fusaria, it would be worthwhile studying, by suitable bio-assay techniques, their production *in vivo* in infected plants. There is no doubt that a clear understanding of the mechanism of these wilts and hence the basis for resistance or susceptibility *vis-a-vis* Fusariose wilts, in general, can follow only a consideration of the metabolism of the host/parasite in all its aspects, especially the *in vivo* toxic and growth factor components of the fungal metabolites. In the case of several Fusaria, infection of certain varieties is known but the disease syndrome characteristic of tracheomycotic wilting does not appear, the hosts acting as

No.
May
"symp-
appea-
tions
gener-
host
toxins
one o-
mecha-
mecha-
produ-
ships
of viv-
tion is
excess-
freed
a cer-
tible
studi-
site r-
planat-
diseas-
unwisi-
case o-
syndro-
on the
innate
son, a-
and a-
in stu-
genera-
has be-

THE
Co-
been a-
tor of
Massac-

Time
the os-
As an
an ato-
constan-
that a-

Cesi
9192-6
serves
metal
heated
cesium
hole in

"symptomless carriers".¹⁶ It would, therefore, appear that in these peculiar instances conditions within the host are not conducive to the generalised spread of the pathogen within the host tissues and to the production of vivotoxins. It should, however, be admitted that one or more factors may be involved in the mechanism of disease resistance, e.g., a host mechanism which may antidote the toxin if produced or one where the substrate relationships are such as to retard or inhibit production of vivotoxins, or else one which allows production in vivo of one or more growth factors far in excess of the amount of the toxic metabolites freed into the system. If one could state why a certain variety of a host should be susceptible and another resistant, from detailed studies on host physiology and the host-parasite relationship, it would then afford an explanation for the mechanism leading to the disease syndrome as we see it. It would be unwise to expect the same mechanism in the case of all Fusarioses, since the final disease syndrome in every case is equally dependent on the innate nature of the pathogen and the innate nature of the host. For this simple reason, a wide range of strains of the pathogens and also of the host plants should be included in studies on this difficult problem, before any general conclusions can be made. From what has been stated, the difficulties in experimen-

tation and the gaps in our knowledge that have to be filled would be obvious. It is to be hoped that future work would clarify the many points raised here.

This brief resume is the result of stimulating discussions I have had with Professor T. S. Sadasivan from time to time, and I am deeply indebted to him for the same.

1. Smith, E. F., *Bull. U. S. Dept. Agric. Div. Veg. Path.*, 1899, **17**.
2. Hutchinson, C. M., *Mem. Dept. Agric. India. Bact. Ser.*, 1913, **1**, 67.
3. Gämänn, E., *Adv. Enzymol.*, 1951, **11**, 401.
4. Ludwig, R. A., *Techn. Bull. Macdonald Coll.*, 1952, **20**.
5. Hodgson, R., Peterson, W. H. and Riker, A. S., *Phytopathology*, 1949, **39**, 47.
6. Davis, D., Waggoner, P. E. and Dimond, A. E., *Nature*, Lond., 1953, **172**, 959.
7. Winstead, N. N. and Walker, J. C., *Phytopathology*, 1954, **44**, 153.
8. Sadasivan, T. S. and Subramanian, C. V., *J. Indian bot. Soc.*, 1954, **33**, 162.
9. Sadasivan, T. S. and co-workers, *Proc. Indian Acad. Sci.*, 1955, **41B**, 97.
10. Venkata Ram, C. S., unpublished.
11. Young, H. C. and Bennett, C. W., *22nd Rept. Mich. Acad. Sci.*, 1921, **1920**, 205.
12. Winstead, N. N. and Walker, J. C., *Phytopathology*, 1954, **44**, 159.
13. Gottlieb, D., *Ibid.*, 1943, **33**, 126.
14. Dimond, A. E. and Waggoner, P. E., *Ibid.*, 1953, **43**, 229.
15. Subbarao, N. S., unpublished.
16. Armstrong, G. M. and Armstrong, J. K., *Phytopathology*, 1948, **38**, 808.

CESIUM ATOMIC FREQUENCY STANDARD

THE development of an atomic "clock", the Cesium Atomic Frequency Standard, has been announced by Jerrold R. Zacharias, Director of the Laboratory for Nuclear Science at Massachusetts Institute of Technology.

Time-keeping in the device is controlled by the oscillation of electrons in the cesium atom. As an electron revolves around the nucleus of an atom, it "wobbles" very slightly but at a constant rate. This unvarying rate of oscillation is reflected in the frequency of waves that are emitted.

Cesium has a frequency of approximately 9192·632 Mc./sec., and it is this frequency that serves as the unit of time in the clock. A metal crucible encloses 0·01 g. of cesium. When heated to a temperature of about 100° C. the cesium shoots a stream of atoms through a hole in the crucible. The atoms strike a detec-

tor screen, and their frequency is reported through a complex apparatus. The cesium emits atoms at a rate of about 1 million per second, but the loss is only about 1 µg./day and, for all practical purposes, the clock is perpetual.

Standard time, with 1 sec. equal to 1/86,400 of the mean solar day and generally measured by the frequency of the oscillations of a crystal, is accurate to 10⁻³ sec. The Atomic Frequency Standard is accurate to 10⁻⁴ sec. Zacharias expects, through further development, to obtain accuracy of 10⁻⁶ sec. The Cesium Atomic Frequency Standard is similar to the "maser", (microwave amplification by stimulated emission of radiation) developed recently at Columbia University but operates on a different principle.

ORBITOIDES FAUJASI—THE FIRST ORBITOID FROM THE CRETACEOUS ROCKS OF SOUTH INDIA

L. RAMA RAO

THE occurrence of Orbitoidal foraminifera in the Cretaceous rocks of South India was recorded for the first time by Stoliczka¹ in 1873 during the study of the fossils from the Cretaceous rocks of the Trichinopoly District collected by Blanford² about ten years before, in the course of his geological survey of the area. Stoliczka noticed the Orbitoids in some of the rocks belonging to the Ariyalur group (of Blanford), and mentioned that his material includes "a single well defined species *Orbitoides faujasi* (Defr.) and two doubtful ones". This first record by Stoliczka is naturally of great importance as the starting point for all subsequent studies of South Indian Cretaceous Orbitoids; and it is therefore very necessary that we should have a clear idea of the nature of these Orbitoids and the exact age of their containing beds. Unfortunately much of the original material on which Stoliczka based his observations has been lost; in fact, even Vredenburg³ who wanted to re-examine them in 1908 in connection with his work on the Cretaceous Orbitoides of India, had to be content with only a few "available remnants". So the only information that we have of the first orbital collection is the description given by Stoliczka of the one species he identified in it, viz., *O. faujasi* (Defr.). Even here it would appear that what Stoliczka has given is not the description of an individual type; it seems to be a generalised account of a group of shells on the assumption that all of them belonged to that one species. Regarding the other two "doubtful species" mentioned by him, we know nothing further. It is however important to note that his collection also did include species of orbitoidal shells other than the only one he described, viz., *O. faujasi*.

The next point calling for comment in Stoliczka's report is regarding the beds from which his orbitoids came. He mentions two localities—(I) Niniyur, in white limestone, and (II) Chokanadapuram, in a pinkish earthy limestone—both of them belonging to the Ariyalur group of Blanford. According to Blanford's memoir, the white limestone in locality (I) would belong to his upper Ariyalur division which was Danian in age, while the pinkish earthy limestone of locality (II) would be in his lower Ariyalur whose age was Senonian. In the light of recent stratigraphical

studies⁵ it is clear that both these age indications for the orbitoidal beds are not correct. The white limestone (I) is not a member of the Danian Niniyur group as now defined⁵; it is a pre-Danian bed, just below the Niniyur; the pinkish earthy limestone near Chokanadapuram (II) is not a bed belonging to the lower Ariyalur—it is younger and belongs to the upper part of Blanford's "Middle Ariyalur" division. It is now evident that both the orbitoid-bearing beds referred to in the two localities mentioned by Stoliczka are younger than Senonian and older than Danian; their age would thus be Maestrichtian.⁵

The suggestion arising from the first locality mentioned in Stoliczka's paper that the *O. faujasi* came from a 'Danian' bed led Kossmat twenty-five years later² to strengthen his correlation of the Nerinea beds in the Pondicherry area in which he said he had also noticed similar *Orbitoides* with the Danian, thus indicating a close analogy between the concerned beds in the two areas. But we now know that this correlation based on 'Danian' orbitoids is no longer true; for one thing, the orbitoid-bearing bed near Niniyur is not 'Danian' in age; and for another, Kossmat's *Orbitoides* in the Nerinea beds is not an *Orbitoides*.^{4,5} From recent discoveries of more orbitoids in the Ariyalur area and the stratigraphical position of the containing beds, it is now almost certain that all the orbitoidal beds, including those mentioned by Stoliczka, are of Maestrichtian age. This conclusion fits in nicely with all later studies, and eliminates the 'anomaly' regarding Danian orbitoids about which Vredenburg⁶ was so much worried.

Now, to come back to *Orbitoides faujasi* itself. About thirty years after Stoliczka recorded the presence of this form in the Ariyalur area, Schlumberger described in 1901–02 two species of *Orbitoides* from the upper Cretaceous of Europe, *O. socialis* and *O. minor*, the genotype for the former being *Orbitolites socialis*, Leym. and that for the latter being *Orbitoides faujasi*, Stol. Thus on the basis of Schlumberger's studies, the old *O. faujasi* from the Ariyalur beds would now become *O. minor*.

An outstanding contribution to the study of Orbitoids was made a few years later when in 1907, Silvestri created the new genus *Lepidorbitoides* with *Orbitolites socialis* Leym.

No.
was
diagn
form
necess
essen
work,
of S
toides
long
dorbi
and t
Thus
so-cal
ger h
Lepidi
L. m
Douvi
that
L. so
dimen
treats
called
that t
O. mi
L. m
accord
We
paper
"The
burg
toides
India,
import
There
to the
Schlum
tioned
Orbito
cherry
'undes
Judged
it is c
ing h
studie
genus
same
tions
palaeo
paper
studie
After
red to
study
quite
sive
time,

as the genotype. A complete description was also given of this new genus and its diagnostic characters clearly indicated. This form is now so well known that it is hardly necessary to go into this description. The essential point to note is that after Silvestri's work, it was clear that the *Orbitoides socialis* of Schlumberger is really a *Lepidorbitoides* and should be called *L. socialis*. Not long afterwards, Douville recognised the *Lepidorbitoides* character of *O. minor* Schl. and this form became accordingly *L. minor*. Thus both the two important species of the so-called *Orbitoides* described by Schlumberger had now to be considered as species of *Lepidorbitoides* and designated *L. socialis* and *L. minor* respectively. In his 1916 paper, Douville went a step further and maintained that *L. minor* was practically the same as *L. socialis*, except for some differences in dimensions, and that it should therefore be treated merely as a variety of *L. socialis* and called *L. socialis*, race *minor*. Thus we find that the *O. faujasi* of Stoliczka (1873) became *O. minor* of Schlumberger (1901), and then *L. minor* of Douville (1916), and finally, according to Douville *L. socialis*, race *minor*.

We may at this stage refer to an important paper published by Vredenburg⁶ in 1908 on "The Cretaceous Orbitoids of India". Vredenburg has here given a review of all the *Orbitoides* known till then from the Cretaceous of India, together with a brief description of the important species and their zonal distribution. There is naturally a reference in this paper to the South Indian *Orbitoides* also; following Schlumberger's view *O. faujasi* is here mentioned as a synonym of *O. minor*, and the *Orbitoides* noticed by Kossmat² in the Pondicherry area is considered as a new species 'undescribed' before and named *O. minima*. Judged by his description of these 'Orbitoides' it is clear that Vredenburg at the time of writing his review was not aware of Silvestri's studies (leading up to the creation of the new genus *Lepidorbitoides*) published at about the same time. Nevertheless Vredenburg's descriptions and comments, both stratigraphical and palaeontological, made in the course of his paper are of great value in all subsequent studies of Indian Orbitoids.

After Silvestri's and Douville's work referred to above, rapid progress was made in the study of Orbitoids all over the world, and quite a large number of papers based on intensive studies were published from time to time, with the result that our knowledge of

this important family of fossil Foraminifera has been considerably enlarged from all points of view. With reference to the subject-matter of the present article, special attention should be drawn to a paper by Thiadens⁸ published in 1937 in which he has described 3 species of *Orbitoides* and 4 of *Lepidorbitoides* from the upper Cretaceous beds of Santa Clara Province, Cuba. One of the most important points discussed in this paper is regarding the view expressed by Douville that *L. minor* is not a distinct species, but is merely a variety of *L. socialis*. After studying the type material of both these forms from the Maastrichtian beds of Holland and France respectively, Thiadens has categorically tabulated the diagnostic characters of both side by side, and shown that the two species, *socialis* and *minor*, are quite different and distinct, and that therefore Douville's view regarding their identity is altogether unacceptable. This means that the recognition of *L. minor* as a separate species is quite valid, and we can so go back to the idea that the *O. faujasi* of Stoliczka from the Ariyalur beds is the same as what should now be called *L. minor*.

More recently S. R. Narayana Rao⁹ has raised another doubt about this. In the course of his paper published in 1941 describing a small collection of orbitoids from the Ariyalur beds near Chokanadapuram (one of the localities mentioned by Stoliczka for his *O. faujasi*) he states that Stoliczka's *O. faujasi* from this area is not the same as *L. minor* since the South Indian form differs in several 'structural characters' from the typical *L. minor* of Maastricht (Holland). He has accordingly created a new species *L. blanfordi* and puts the *O. faujasi* of Stoliczka, and the *O. minor* of Vredenburg as synonyms of his new species. While it must be admitted that the case made out by S. R. N. Rao in support of his conclusion is not obvious from the brief descriptions and comparisons given by him, his suggestion is nevertheless important as indicating another possibility which it would be worthwhile to further investigate.

If only we could recover the entire collection of the Ariyalur Orbitoids which Stoliczka had before him in 1873 when he wrote his report, and re-examine them now on modern lines, it would indeed be a most valuable contribution in solving many of our doubts and difficulties regarding their exact nature and identity; but this is evidently out of the question. Luckily for us, however, we have quite recently found a very rich occurrence of orb-

toids in some of the beds near Ariyalur.⁶ This material is now being studied in detail by the present author, and a full paper on this subject will soon be published elsewhere. From the present collection it is clear that the Orbitaloids in the Cretaceous rocks of South India are both rich and varied, affording opportunities for work of the greatest interest and importance; and when one is engaged in these studies, his mind frequently goes back to Blanford and Stoliczka whose pioneer investigations

nearly a hundred years ago mark the starting point in this fascinating field of research.

1. Blanford, H. F., *Mem. Geol. Surv. India*, 1865, 4, 1.
2. Kossmat, F., *Rec. Geol. Surv. India*, 1897, 30, 2.
3. Rao, S. R. N., *J. Mys. Uni.*, 1941, 2, 9.
4. Rama Rao, L., *Curr. Sci.*, 1939, 8, 4.
5. —, *Lucknow Univ. Studies*, 1942, 17.
6. —, *Curr. Sci.*, 1953, 22, 3.
7. Stoliczka, F., *Pal. Indica*, 1873, 4.
8. Thiadens, A. A., *J. Pal.*, 1937, 11, 2.
9. Vredenburg, E., *Rec. Geol. Surv. India*, 1908, 36, 3.

INDIAN AGRICULTURAL RESEARCH INSTITUTE, NEW DELHI, 1905-1955

THE Indian Agricultural Research Institute, New Delhi, popularly known as the Pusa Institute, is fifty-years-old this year and celebrated its Golden Jubilee from 1st to 4th April 1955. The Institute, whose establishment in 1905 at Pusa, Bihar, was facilitated by the liberal donation of £ 30,000 given by an American philanthropist, Mr. Henry Phipps, to Lord Curzon was located at Pusa until the great Bihar earthquake of 1934 caused irreparable damage to the laboratory buildings. It was then decided to shift the Institute to New Delhi. An area of over 1,000 acres was acquired, new laboratories and buildings were constructed and Lord Linlithgow, the then Vice-roy and Governor-General, declared the new buildings open in November 1936.

There are at present six major divisions within the Institute: (1) Agronomy, (2) Botany, (3) Soil Science and Agricultural Chemistry, (4) Agricultural Engineering, (5) Entomology, and (6) Mycology and Plant Pathology. Each of these divisions has separate buildings and experimental area. Besides the Central Library, which receives over a thousand different periodicals and is considered to be the best agricultural library in the East, the different divisions have libraries of their own. The Institute has also three substations at Pusa (Bihar), Karnal and Simla.

Among the early scientists on the staff of the Institute were such eminent authorities as Dr. E. J. Butler in the field of Mycology, Sir Albert Howard in the field of Plant Breeding and Prof. M. Lefroy and Dr. T. B. Fletcher in Entomology. Due to the interest and initiative of these men and the workers who followed them an extensive collection of varieties of crop plants the vast National Pusa collection of insects and the Herbarium Cryptogamæ Indiæ Orientalis have been built up and are now in constant use by research staff and students.

The Institute has had a fine record of achievement in the matter of contributions to

both the fundamental and applied aspects of the different branches of agricultural science.

One of the important activities of the Institute is the provision of post-graduate training to students and deputees of Agricultural Departments from the different States of India. The students have the choice of nearly twenty different two-year courses for each of which there is a carefully planned syllabus. Hundreds of such trained men now occupy important positions throughout the country. Several students from neighbouring Asiatic countries are also now enrolling themselves for the post-graduate course at the Institute. During the past five years, the Central College of Agriculture which imparts undergraduate training leading to the B.Sc. Degree of the Delhi University is also located in the Institute.

Recently, the Institute has undertaken agricultural extension work in Delhi villages. Besides, it co-operates with the Food and Agricultural Organisation of U.N. in the maintenance and description of genetic stocks of wheat and with the Technical Co-operation Mission of the United States in conducting trials of certain fertilizers in different parts of India. On the eve of the Golden Jubilee, the Institute is on the threshold of further expansion. To satisfy the increased requirements of trained personnel in connection with the various agricultural development schemes put into operation under the Five-Year Plan, provision is being made for training more post-graduate students. A new hostel which can accommodate 100 more students has been constructed. On the research side, a laboratory for undertaking research on trace elements has been completed. A cartographic laboratory will also soon start functioning. Also, the existing laboratories are being provided with additional green houses and new equipment. With a tradition so rich the Institute may well look forward to the future with a sense of awareness of the part they can and should play in the betterment of crop production and animal husbandry in India.

No.
May 1

Scatter
Non-
K. M.

Force
Type
KRIS

Chromo-
State
A. M.

Banded
Srika
RAO

Measur-
Horn
Absor

Prepara-
V. V.

Twin
Gran
Rock
Bang

The Co-
Bark-
AND

Nutritio

busa
LAKS
MANI

Separat

Lead
graph
V. A.

Depend
quenc

Surfa

AND

Prevent

B. K.
CHOU

SCA
NU

THE fol
the aut
of high
(k₁/k) =

Here V
well, f
tering

*

LETTERS TO THE EDITOR

PAGE	PAGE		
Scattering of High Energy Nucleons by Non-Uniform Nuclei—G. Z. SHAH AND K. M. GATHA	151	Oxysporin, A New Antibiotic from <i>Fusarium oxysporum</i> Schlecht—M. O. TIRUNARAYANAN AND M. SIRSI	162
Force Constants of the Radicals of XY ₄ Type—K. VENKATESWARLU AND M. G. KRISHNA PILLAY	152	The ABO Blood Groups of Kumaonis—G. W. G. BIRD AND P. KRISHNASWAMY	162
Chrome Phengite from Belvadi, Mysore State—M. G. CHAKRAPANI NAIDU AND A. MOHAMED KHAN	153	An Alternative Convention for pH—K. S. MURTY	163
Banded Manganiferous Cherts from Sriakulam District—J. S. R. KRISHNA RAO AND C. MAHADEVAN	154	Osteology of Catfishes—H. R. SRINIVASCHAR	164
Measurement of Extinction Angles in Hornblendes which show Strong Absorption—P. R. J. NAIDU	154	Abnormalities in the Flowers of <i>Dolichos lablab</i> , <i>Vulgaris savi</i> —S. K. PILLAI	164
Preparation of o-Bromacetophenone—V. VENKATESWARLU	155	On the Nature of Primary Vascular Tissue in the Tendril of <i>Vitis pallida</i> W. & A.—J. J. SHAH	165
Twin Laws of Plagioclase Feldspars of Granites, Gneisses and Associated Rocks of Closepet (Ramanagaram), Bangalore Dist.—K. V. SURYANARAYANA	156	A Contribution to the Embryology of <i>Opilia amentacea</i> Rorb.—S. SHAMANNA	165
The Colouring Matters of Ponderosa Pine Bark—E. F. KURTH, V. RAMANATHAN AND K. VENKATARAMAN	157	Sporeling Germination Studies in <i>Cryptomitrium himalayensis</i> Kash.—P. KACHROO	167
Nutritive Value of Bamboo Seeds (<i>Bambusa arundinacea</i> , Willd.)—M. V. LAKSHMINARAYAN RAO, N. SUBRAMANIAN AND M. SRINIVASAN	157	An Undescribed Species of <i>Protomyces</i> on <i>Crotalaria triquetra</i> Dalz.—N. C. JOSHI	168
Separation of Silver, Mercurous and Lead Ions by Circular Paper Chromatography—A. R. VASUDEVA MURTHY, V. A. NARAYAN AND M. R. A. RAO	158	Malformation Disease of Mango (<i>Mangifera indica</i> Linn.)—S. M. SINGH	168
Dependence of Hysteresis in Low Frequency Electric Discharge on Electrode Surface—N. A. RAMAIAH, B. D. KHOSLA AND H. C. GAUR	160	Occurrence of Double Flowers and Polycarpy in the Genus <i>Cicer</i> Linn.—S. P. SINGH AND T. R. MEHTA	169
Prevention of Choline Toxicity in Rats—B. K. NANDI, D. BANERJEE AND S. CHOUDHURI	161	Photoperiodic Response in Til (<i>Sesamum indicum</i> Linn.)—B. N. GHOSH	170
		Linkage of "Pale Green Leaf" with "Curled Leaf" in <i>G. herbaceum</i> —N. R. BHAT AND N. D. DESAI	170
		Somatic Chromosomes of <i>Anthericum variegatum</i> Hort. ex Fl.—B. D. DESHPANDE	171
		Structure and Development of Nutmeg Seed—R. L. N. SASTRI	172
		Rates of Initiation in the Polymerisation of Methyl Acrylate—M. SANTHAPPA AND V. MAHADEVA IYER	173

SCATTERING OF HIGH ENERGY NUCLEONS BY NON-UNIFORM NUCLEI

The following relation (Eq. 1) was derived by the authors¹ while dealing with the scattering of high energy nucleons by uniform nuclei:

$$(k_1/k) = [((E + V)^2 - \mu^2 c^4)/((E^2 - \mu^2 c^4)]^{1/2} - 1 - (\pi \rho_0 / k^2) \\ \{f_{nn}(0) + f_{np}(0)\} \quad (1)$$

Here V is the depth of the nuclear potential well, $f_{nn}(0)$ and $f_{np}(0)$ are the forward scattering amplitudes for (n, n) and (n, p) scat-

tering respectively to be evaluated within the nucleus, and ρ_0 is the nuclear density. The complex refractive index of nuclear matter is then given by

$$n = 1 + (k_1/k) + i(K/2k) \quad (2)$$

It is possible to extend the method to spherically symmetric non-uniform nuclear density distributions by applying the above formalism at each point in the nucleus for a particular value of the energy. Table I gives the total cross-sections calculated in this way for the

scattering of 90 Mev nucleons by a number of light elements. The nuclear potential well for the scattering of 90 Mev nucleons was obtained by evaluating $f_{nn}(0)$ and $f_{np}(0)$ from the Jastrow² as well as the Christian^{3,4} models for nucleon-nucleon scattering, using the non-uniform characteristic nuclear density distribution obtained by Gatha, Shah and Patel.⁵ Using these potential wells the radial distributions of k_1 were determined. The radial distribution of the absorption parameter K was obtained from the formula

$$K = (\epsilon \rho / 2) (\sigma_{nn} + \sigma_{np}) \quad (3)$$

where ϵ is the exclusion factor, and σ_{nn} , σ_{np} are the (n, n) and (n, p) scattering cross-sections respectively to be evaluated within the nucleus. We have used $\sigma_{nn} = \sigma_{np}$ and evaluated σ_{np} from the curves given by Hildebrand⁶ at the kinetic energies within the above potential wells. The exclusion factor ϵ has been left undetermined at this stage. The radial distributions obtained above can be closely fitted by the expressions:

$$k_1(\bar{r}) = a_1 \exp(-b\bar{r}) \quad (4)$$

$$K(\bar{r}) = a_2 \exp(-b\bar{r}) \quad (5)$$

where $a_1 = 9.2 \times 10^{12} \text{ cm}^{-1}$, $a_2 = 23.9 \times 10^{12} \text{ cm}^{-1}$, for the Jastrow model and $a_1 = 14.3 \times 10^{12} \text{ cm}^{-1}$, $a_2 = 20.8 \times 10^{12} \text{ cm}^{-1}$, for the Christian model, while $b = 1.94 \times 10^{13} \text{ cm}^{-1}$ for both models and $\bar{r} = r \times A^{\frac{1}{3}}$ where A is the nuclear mass number.

To evaluate the total cross-sections σ_t for the scattering of 90 Mev. nucleons, the generalisation for non-uniform nuclei⁷ was employed, which gave

$$\sigma_t = 4\pi A^{2/3} \int \tilde{\rho} d\tilde{\rho} [1 - e^{-\tilde{a} \tilde{\rho} K_1(b\tilde{\rho})}] \cos(\tilde{\beta} \tilde{\rho} K_1(b\tilde{\rho})) \quad (6)$$

where $\tilde{a} = a_2 A^{\frac{1}{3}}$, $\tilde{\beta} = 2 a_1 A^{\frac{1}{3}}$ and $K_1(z)$ is the Bessel function of z in the usual notation. Using this expression σ_t was calculated for both the models and the results were compared with the experimental values of Cook et al.⁸ If ϵ is taken to be 0.66 following Fernbach et al.,⁹ then the Jastrow model gives slightly higher values for σ_t while the Christian model gives about twice the experimental values. Thus the Christian model appears to be unsuitable for this purpose. Using the Jastrow model, the best agreement with the experimental results is obtained if $\epsilon = 0.58$. The values for σ_t calculated in this way are tabulated in Table I.

The study thus indicates that the usual optical model formalism for uniform nuclear density distributions can be generalised to deal

TABLE I

Element	Total cross-sections in millibarns	
	Theoretical	Experimental
Li	..	324 ± 6
Be	..	421 ± 8
C	..	548 ± 11
N	..	656 ± 21
O	..	765 ± 20
Mg	..	1030 ± 20
Al	..	1120 ± 20

with the non-uniform nuclear density distributions and further that the characteristic nuclear density distribution proposed by the authors previously on the basis of the nuclear scattering of 340 Mev nucleons and the optical model parameters determined on the basis of the above formalism can reasonably account at least for the total scattering cross-sections at 90 Mev.

M. G. Science Institute,
Navarangpura,
Ahmedabad-9, February 15, 1955.

G. Z. SHAH.
K. M. GATHA.

- Shah, G. Z. and Gatha, K. M., *Curr. Sci.*, 1954, **23**, 395.
- Jastrow, R., *Phys. Rev.*, (L), 1951, **81**, 630.
- Christian, R. S. and Hart, E. W., *Ibid.*, 1950, **77**, 441.
- Christain, R. S. and Noyes, H. P., *Ibid.*, 1950, **73**, 85.
- Gatha, K. M., Shah, G. Z. and Patel, N. J., *Proc. Phys. Soc.*, 1954, **67**, 773.
- Hildebrand, R. H. (Private Communication).
- Gatha, K. M. and Mathur, A. L., *Curr. Sci.*, 1955, **24**, 43.
- Cook, L. J., McMillan, E. M., Peterson, J. M. and Sewell, D. C., *Phys. Rev.*, 1949, **75**, 7.
- Fernbach, S., Serber, R. and Taylor, T. B., *Ibid.*, 1949, **75**, 1352.

FORCE CONSTANTS OF THE RADICALS OF XY₄ TYPE

WILSON¹ developed the group-theoretical method of obtaining the normal frequencies making use of the symmetry co-ordinates. In this method the elements of F and G matrices relating to the potential and kinetic energies respectively are obtained. From these matrices the equations giving the normal frequencies in terms of the force constants are deduced.

In the present investigation the force constants of four inorganic radicals all belonging to the symmetry group T_d have been calculated from the observed Raman frequencies which are taken from Landolt-Bornstein tables. In the following table, r_1 corresponds

TABLE I

Radical	Observed frequencies				$f_d \times 10^{-5}$	$f_{da} \times 10^{-5}$	$f_a \times 10^{-5}$	$f_{aa} \times 10^{-5}$	Calculated frequencies				d in Å Badger's rule
	ν_1	ν_2	ν_3	ν_4	dynes cm. ⁻¹	dynes cm. ⁻¹	dynes cm. ⁻¹	dynes cm. ⁻¹	ν_1	ν_2	ν_3	ν_4	
AsS ₄	386	171	419	216	2.818	0.4135	0.3123	0.0570	386	171	437	207	1.87
SbS ₄	366	156	380	178	2.534	0.5153	0.3669	0.1063	366	156	401	167	2.28
NH ₄	3040	1680	3145	1400	5.495	0.5980	0.6144	0.0275	3040	1680	3147	1405	1.03
ND ₄	2214	1215	2346	1065	5.829	0.6560	0.6285	0.0218	2214	1215	2360	1059	1.02

Details will be published elsewhere.

to the non-degenerate A₁ type vibration, ν_2 the doubly degenerate E type vibration and ν_3 and ν_4 , the triply degenerate T₂ type vibrations. The procedure adopted here in the evaluation of force constants is similar to the one described by Cleveland.² The force constants f_d , f_a , f_{aa} and f_{da} have the usual significance. As the equations involving the force constants do not yield real roots, the method of successive approximations has been used in this investigation and the force constants which form the best fit in the equations are evaluated. The observed frequencies, the force constants obtained in this investigation and the frequencies calculated therefrom are given in Table I. In the last column are given the internuclear X-Y distances as obtained from the f_d values of the present investigation, using Badger's rule.³

Physics Dept., K. VENKATESWARLU.
Annamalai University, M. G. KRISHNA PILLAY.
Annamalainagar,
February 25, 1955.

1. Wilson, E. B., *J. Chem. Phys.*, 1939, 7, 1047; 1941, 9, 76.
2. Cleveland, F. F., *Amer. J. Phys.*, 1946, 14, 13.
3. Badger, R. M., *J. Chem. Phys.*, 1934, 2, 128; 1935, 3, 710.

CHROME PHENGITE FROM BELVADI, MYSORE STATE

MENTION of the occurrence of Fuchsite quartzites in Mysore has been made by the officers of the Mysore Geological Department¹ and the brilliant green mica contained in these rocks has been referred to as fuchsite, a chrome muscovite. The green mica occurring in one such quartzite from Belvadi, has been subjected to a detailed investigation of its optical properties, as a result of which we have now identified it as a phengite.

The mineral, under investigation, shows the following optical properties:

The relief is distinct with serrated borders and the birefringence is strong. It shows almost straight extinction and is pleochroic with the following scheme: X = pale greenish blue; Y = yellowish green; and Z = dark bluish green.

It is optically negative with 2V = 32°, as determined on the Federov's Universal Stage. The refractive indices, β and γ of the mineral were determined by the immersion method while the α value was calculated from the other two values of the indices and the optic axial angle. They are: $\alpha = 1.558$, $\beta = 1.595$, $\gamma = 1.598$, and $\gamma - \alpha = 0.040$ (-) 2V = 32°.

When the β and 2V of the mineral are plotted in Winchell's variation diagram for the muscovite system of minerals,² it is found that the mineral is rich in phengite molecule.

The mineral has been kindly analysed for its chromium content by Sri. T. D. Bhasker, Department of Chemistry, Central College, Bangalore, and is found to contain 0.98% Cr₂O₃.

It is evident from the above optical and chemical study, that the mineral, under investigation, is a chrome mica which is a member of the muscovite system, being rich in phengite and poor in muscovite molecules. Hence it is a chrome phengite and not fuchsite. Further work involving chemical and X-ray analyses of this mineral from other localities in Mysore will be done and a more detailed paper embodying the results of such work will be published elsewhere.

The authors desire to thank Dr. C. S. Pichamuthu for his interest in the work and valuable suggestions.

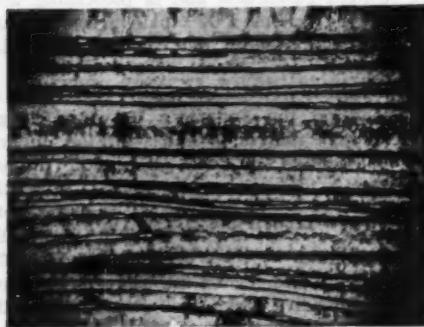
Dept. of Geology, M. G. CHAKRAPANI NAIDU.
Central College, A. MOHAMED KHAN.
Bangalore, February 11, 1955.

1. *Mysore Geological Records*, 1934, 33, 119.

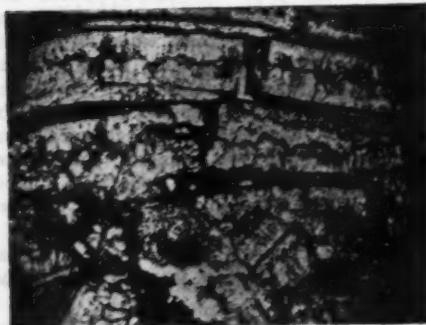
2. Winchell, *Elements of Optical Mineralogy*, 1951, 2, 308, Fig. 254.

BANDED MANGANIFEROUS CHERTS FROM SRIKAKULAM DISTRICT

CHERTS usually brown, black and sometimes variegated, occur abundantly in association with manganese ores, and manganese bearing rocks of Visakhapatnam and Srikakulam Districts. They are found as irregular masses in the manganese ore body. The cherts occurring in manganese quarry of Echcherla (Sheet 65 N, Long. $83^{\circ}53'$ and Lat. $18^{\circ}18'$, 6 miles southwest of Srikakulam) collected by one of us (C. M.) show banding which has not been reported earlier. These consist of alternate bands of chert and manganese ore which are light and dark-coloured respectively (Fig. 1). The



manganese bands occasionally contain ferruginous material and garnet, the latter often showing lenticular forms. The bands sometimes show miniature foldings. There are cracks in the bands and they are filled with manganese (Fig. 2). The chert shows devitrification, and



some small druses in the chert band contain minute crystals of quartz.

Fermor¹ considered the cherts associated with the manganese ores of these areas as due to the alteration of manganese silicates and de-

position of the released silica in a colloidal state, but, it appears that these banded manganeseiferous cherts are sedimentary in nature. This conclusion is based on the fact that, the alternate banding of manganese and silica resembles stratification, a primary feature of sedimentary rocks. The banding is also more or less uniform and does not show much irregularity. Furthermore, the banding in the chert is parallel and conformable with the gneissosity of the associated paragneisses, and mineralogically, again, these are similar to quartz-manganese-garnet associations of Madhya Pradesh which are considered to be of definite sedimentary origin. Harold L. James² discussing a similar problem of the banded cherts suggested that they are of the nature of primary precipitates.

The occurrence of the garnets and the presence of ferruginous material in the manganese ore bands suggests the original impure nature of manganese deposition. The cracks and the druses found in the bands are suggested to be due to the space created on volume shrinkage during the process of devitrification of the colloidal silica. Finally, it may be stated that the origin of these banded manganeseiferous cherts is of considerable interest, suggesting an original sedimentary nature of the manganese deposits of these areas, similar to the manganese deposits of Madhya Pradesh. Dept. of Geology, J. S. R. KRISHNA RAO. Andhra University, C. MAHADEVAN. Waltair, March 5, 1955.

1. Fermor, *G. S. I. Mem.*, 1909, **37**, 203, Pt. II.
2. Harold, L. James, *Econ. Geol.*, May 1954, **49** (3), 273.

MEASUREMENT OF EXTINCTION ANGLES IN HORNBLENDES WHICH SHOW STRONG ABSORPTION

BUDDINGTON AND LEONARD¹ have commented on the difficulty of measuring accurately the extinction angles of hornblendes in north-west Adirondack granite rocks. These hornblendes showed strong absorption parallel to Y and Z, and weak absorption parallel to X. Hornblendes showing similar absorptions occur in Charnockites. The most reliable method of measuring extinction angles is on (100) twins of hornblende, as outlined by Turner.² Such twins do not occur in the hornblendes of Charnockites. Therefore, the following two methods were tried, both on the Fedorow stage. The use of the stage is after Reinhard.

(1)
both
also
pole
Thes
(Fig

in the
trix a
the t
gamm
to X
is dra
gives
angle
jection

(2)
tion o
before
axes,
stereo
transfe
project
Biot-F

(1) In a grain showing the emergence of both the optic axes, beta (Y) was located as also the emergence of the two optic axes. The pole of the cleavage trace was also located. These were drawn in stereographic projection (Fig. 1). The determination of the optic sign,

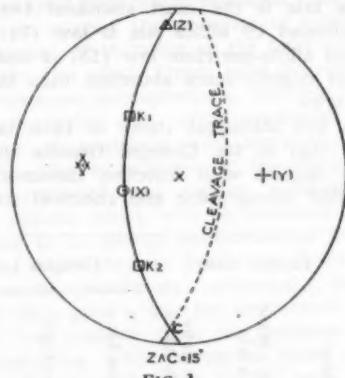


FIG. 1

in this case, negative, enabled the acute bisectrix alpha (X) to be located midway between the two optic axes. The third ellipsoidal axis, gamma (Z) may, if necessary, be located polar to XY plane. The trace of the cleavage plane is drawn, and its intersection with the XZ plane gives the emergence of C, and therefrom the angle ZAC is measured in stereographic projection.

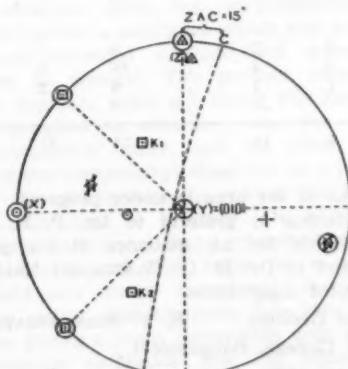


FIG. 2

(2) The second method is by the application of the Biot-Fresnel law of extinction. As before, beta (Y), the emergence of the optic axes, and the cleavage pole are located in stereographic projection. The stereogram is transformed with beta (Y) as the centre of projection. The constructions required by the Biot-Fresnel law are now drawn, the trace of

the cleavage plane on (010) is C, and the angle ZAC is read off in radian measure.

Both the above methods eliminate difficulties arising out of strong absorption parallel to Z, and the results are accurate to a degree. Determinations made on 10 grains gave values from 14-15°.

My sincere thanks are due to S. Ramanathan, Research Assistant of this Department, for furnishing the above data from his study of Hornblendes of Charnockites from Salem. Dept. of Geol. & Geophys., P. R. J. NAIDU. University of Madras, Madras-25, March 7, 1955.

1. Buddington, A. F. and Leonard, B. F., *Amer. Min.*, 1953, **38**, 891.
2. Turner, F. J., *Amer. J. Sci.*, 1942, **240**, 571.

PREPARATION OF *o*-BROMACETO-PHENONE

The procedure of Elson, Gibson and Johnson¹ for the preparation of *o*-bromacetophenone is cumbersome and gives poor yields because of the difficulties in nitration and reduction. The same substance can be synthesised in good yields by reduction of the diazoketone obtained from ortho-bromo-benzoyl chloride, with hydriodic acid.

Ortho-bromo-benzoic acid² (5.0 g.) was treated with thionyl chloride (10 ml.) in the cold, and the acid chloride formed at the end of about 2 hours was distilled; b.p. 150° C./22 mm. Yield, 4 g. A solution of the acid chloride (4 g.) in dry ether (20 ml.) was added in small quantities, to a solution of an excess of diazomethane (3-4 moles.) in dry ether. After careful removal of the solvent by evaporation, the resulting diazoketone was taken up in chloroform (15 ml.) and shaken with excess of hydriodic acid (15 ml., d. 1.72). The reaction mixture was then decomposed by treatment with an aqueous solution of sodium sulphite and extracted with ether. Removal of the solvents left the *o*-bromacetophenone as a liquid, b.p. 92° C./2-5 mm. Yield, 3 g. It was further characterised by its oxime, 2:4-dinitrophenylhydrazone and semicarbazone¹ derivatives. Oxime (crystallised from alcohol), m.p. 130-32°. Found: N, 6.7%; C₈H₇ONBr requires N, 6.5%. 2:4-Dinitrophenylhydrazone (crystallised from alcohol), m.p. 203°. Found: N, 14.7%; C₁₄H₁₁O₄N₄Br requires N, 14.8%. Dept. of Chemistry, V. VENKATESWARLU. Andhra University, Waltair, January 31, 1955.

1. Elson, Gibson and Johnson, *J.C.S.*, 1930, 1130.
2. Gräbe, *Ann.*, 1893, **276**, 56.

**TWIN LAWS OF PLAGIOCLASE
FELDSPARS OF GRANITES, GNEISSES
AND ASSOCIATED ROCKS OF CLOSE-
PET (RAMANAGARAM), BANGALORE
DIST.**

PLAGIOCLASE feldspars from granites, gneisses and associated rocks occurring in an area of about 112 square miles around Closepet were examined on the universal stage. Two hundred and thirteen grains in 39 rock sections cut from 11 rock types were determined for the anorthite content and twin laws according to the method of Reinhard.¹ The distribution of twin laws in various rock types is shown in the table.

Rock Type	Anorthite %	Normal Law			Parallel Law			Complex Law		
		Albite	Manebach	Raveno	Carlsbad	Aklin = Manebach Aklin	Aklin = Manebach Aklin	Albite-Alia	Albite-Carlsbad	Combined Albite-Pericline
1 Pink porphyritic granite	23-27	10	1	..	..	2	..	13	..	..
2 Grey porphyritic granite	23-30	6	..	..	..	1	..	5	1	3
3 Coarse grained Closepet granite	..	20-27	9	1	.	..	2	..	..	2
4 Medium grained grey granite	22-27	14	..	..	..	..	..	5	..	2
5 Medium grained pink granite	..	22-25	..	1	..	..	..	..	..	..
6 Medium grained pink and grey granite	..	22-28	1	1	..	..	1	..	..	..
7 Fine grained grey and pink granite	..	23-25	1	..	..	..	..	2	..	..
8 Syenite	..	23-35	11	2	..	..	..	..	6	5
9 Banded gneiss	..	22-33	17	1	..	..	4	..	18	3
10 Hornblende Schist	..	20-33	7	2	..	..	1	..	6	2
11 Amphibolite	..	27-37	10	..	..	..	..	7	..	3
Total (213)	..	86	9	..	5	13	..	74	11	15

The nature of simple, parallel and complex laws was checked by constructing the pole of the twin axis by Nikitin's method. The now well known conflict between albite law and albite Alia B law occurred for plagioclases of composition 25-29%. (Raghavan,² Ramanathan³ and Coulson⁴). The conflict was resolved by applying Coulson's check and Nikitin's construction.

Coulson has indicated the frequency of albite Alia B twins in plagioclases of 33% anorthite. The author, however, has noted the frequent occurrence of albite Alia B twins in plagioclase feldspars of 22-27% An in the rocks of Closepet region. Similar evidences have been noted by Raghavan and Ramanathan in their areas.

It will be significant from the table that the plagioclases in all the rock types of Closepet are acid oligoclases containing 20-28% anorthite. The plagioclases in syenites, banded gneisses, hornblende schist and amphibolite are basic oligoclases with 30-37% anorthite.

Albite law is the most abundant twin law (86) followed by albite Alia B law (74). The combined albite-pericline law (15) is less common, but slightly more abundant than the rest of the laws.

From this statistical study of twin laws, it appears that in the Closepet Granite complex we are dealing with injection metamorphism. A detailed petrographic and chemical study of

the rocks of the area is under progress.

The author is grateful to Dr. P. R. Jagapathy Naidu for his guidance in the present work, and to Dr. M. G. Chakrapani Naidu for his helpful suggestions.

Dept. of Geology, K. V. SURYANARAYANA,
Central College, Bangalore-1,
March 10, 1955.

1. Reinhard, M., *Universal Drehtischmethoden*, 1931, Weff & Co., Basel, p. 119.
2. Raghavan, V. M., *J. Madras. Univ.*, 1954, 24B, 345.
3. Ramanathan, S., *Ibid.*, 1954, 24B, 229.
4. Coulson, A. L., *Records, Geol. Surv. India*, 1932, 65, 173-84.

THE COLOURING MATTERS OF PONDEROSA PINE BARK

In a recent note Gupta, Kurth and Seshadri¹ have described the isolation of 2:3-dihydroquercetin (taxifolin) from the bark of *Ponderosa* pine. Comparison of R_f values in paper chromatography and colour reactions have also led them to suggest the presence of quercetin and myricetin. Methylation of the total colouring matters and alkali fission gave 2-hydroxy- ω :4:6-trimethoxyacetophenone, veratric acid and trimethylgallic acid, which "indicated that a mixture of quercetin and myricetin was involved". Our examination of the *Ponderosa* colouring matters² has yielded substantially different results, which will be discussed fully in a paper to be shortly communicated to the *Journal of Scientific and Industrial Research*.

The crude *Ponderosa* colouring matter (m.p. 275-85°) gave a test for flavononols, and taxifolin was isolable from the aqueous extract. Extraction with petroleum ether indicated the presence of about 2% of wax. The crude colouring matter was chromatographed on a column of Florex, using ethyl acetate (in which 94% was soluble) as solvent. The percolate yielded a yellow substance, which gave neither the gossypetone test nor the green colour with aqueous potassium carbonate given by the crude colouring matter. Crystallization of this material from aqueous acetone led to quercetin. Concentration of the mother liquor obtained from the crystallization of quercetin yielded a substance which was methylated with dimethyl sulphate and potassium carbonate in acetone. The product separated into two fractions when a benzene solution was chromatographed on alumina; one was quercetin pentamethyl ether, and the other, m.p. 164°, was the pentamethyl ether (I) of a penta-hydroxy-C-methylflavone to which the name pinoquercetin may be assigned. On a column of powdered cellulose, using a mixture of either butanol, acetic acid and water or *m*-cresol, acetic acid and water³ as solvent, the crude colouring matter was separable into two fractions, one giving a green colouration with aqueous potassium carbonate and the other not answering this test. The former fraction contained a new flavonol, which it is proposed to designate as pinomyricetin. Acetylation with acetic anhydride and pyridine gave a derivative, m.p. 228-30°, analysing for a hexacetoxy-C-methylflavone. On methylation with dimethyl sulphate and potassium carbonate in acetone a hexamethoxy-C-methylflavone (II), m.p. 178°, was obtained.

When the crude *Ponderosa* colouring matter was methylated with dimethyl sulphate and potassium carbonate in acetone and the product was fractionated by a procedure involving crystallization as well as chromatography on alumina, three crystalline polymethoxyflavones were obtained: (1) quercetin pentamethyl ether; (2) pinoquercetin pentamethyl ether (I), m.p. 164°; and (3) the hexamethyl ether (II), m.p. 178°, of pinomyricetin. Alkali fusion of both the polymethoxy-C-methylflavones (I) and (II) gave the same ketone, identified by synthesis as 2-hydroxy- ω :6:6-trimethoxy-5-methylacetophenone; in addition, (I) gave veratric acid, and (II) trimethylgallic acid. Pinoquercetin is therefore 6-methylquercetin,⁴ and pinomyricetin 6-methylmyricetin. Strobochrysin is the only C-methylflavone whose occurrence in nature has been previously recorded,⁵ although C-methyl-derivatives of chromones, flavanones and flavononols have been found in plants.

Dept. of Chem. Tech., E. F. KURTH.
University of Bombay, V. RAMANATHAN.
Bombay; and K. VENKATARAMAN.
Oregon Forest Products Lab.,
Corvallis, Oregon,
U.S.A., April 25, 1955.

1. Gupta *et al.*, *J. Sci. Ind. Res.*, 1954, **13B**, 886.
2. Ramanathan and Venkataraman, *Proc. Indian Acad. Sci.*, 1954 **39A**, 90.
3. Bate-Smith, *Biochemical Society Symposia*, No. 3, 1949, 62.
4. Jain and Seshadri, *J. Sci. Ind. Res.*, 1955, **12B**, 564; 1954, **13B**, 539.
5. Lindstedt and Misiorny, *Acta Chem. Scand.*, 1951, 5, 1.

NUTRITIVE VALUE OF BAMBOO SEEDS (*BAMBUSA ARUNDINACEA*, WILLD.)

BAMBOO seed—popularly known as 'Bamboo Rice'—is a reputed famine food. It has been reported¹ that thousands of people sustained themselves on these seeds in times of scarcity in the past. Normally it is only consumed by the hill and forest tribes. Although the bamboo flowers once—and once only—towards the end of its life-span of 15-20 years, very large quantities of the seeds are said to be available during the season in the tracts where bamboos abound. Apart from the chemical composition of some varieties,^{2,3} there is little information on the nutritive value of the seeds. Investigations on this aspect were, therefore, undertaken in this laboratory as part of a programme of work on little known foods.

The husked seeds grossly resembled rice, but closer examination showed that they were more like wheat. As compared with rice, the grains had a thicker and tougher bran-coat which was difficult to polish completely. The fully, or partially, polished grains cooked like rice but were slightly more glutinous. Unpolished grains required a longer time for cooking. The grains could be consumed either in the cooked form or as various culinary preparations (*chappatis*, etc.), made out of the flour.

The percentage composition of the husked seeds was as follows: moisture 10.0, crude protein 12.0, ether extractives 0.9, ash 1.1, fibre 2.6, carbohydrates (by difference) 73.4, calcium 25.0 mg %, phosphorus 218.0 mg %, iron 9.2 mg %, vitamin B₁ 0.1 mg. (33.3 International Units) %, nicotinic acid 2.03 mg %, riboflavin 36.3 µg %, carotene 12 µg % (20 International Units of vitamin A) and calorific value 98.0 calories per ounce. Fractionation studies revealed that the major proteins of the seed were glutelins with isoelectric point at pH 4.6. The amino acid make up of the proteins—as determined by the two-dimensional paper chromatographic procedure developed in this laboratory⁴—showed that they were well provided with all the essential amino acids.

Employing rat-bioassay procedures,^{5,6} the digestibility coefficient, biological value and protein efficiency ratio of the seed protein were determined at a dietary level of 10%, using the whole seed as the protein source. The effect of complete substitution of rice by the bamboo seed in a conventional poor rice diet⁷ on its over-all nutritive value was also ascertained by rat-growth experiments. The results are summarised in Table I.

TABLE I
Nutritive value of bamboo seeds

Nutritive value of Protein		
Digestibility Coefficient	..	90.1 ± 0.96
Biological Value	..	74.4 ± 1.44
Protein Efficiency Ratio	..	1.96 ± 0.07
Replacement Value in Rice Diet		
	Growth Rate (g. per rat)	
	per week	per 100 g. food ingested
Poor rice diet	..	5.1 ± 0.36 7.9 ± 0.37
Bamboo rice diet	..	7.9 ± 0.37 12.8 ± 0.65

It is evident from the above results that the biological value of the bamboo seed proteins is

as high as that of rice proteins and higher than that of wheat proteins. In the matter of protein content, the seeds are comparable with wheat but superior to rice. The complete replacement of the rice in a poor rice diet by the seeds enhances its growth-promoting value by about 50%. Thus, in over-all nutritive value, the seeds excel both rice and wheat.

Our grateful thanks are due to Dr. V. Subrahmanyam for his keen interest in the work and to the Provincial Silviculturist, Ootacamund, for the supply of bamboo seeds.

M. V. LAKSHMINARAYAN RAO,
N. SUBRAMANIAN,

Central Food
Tech. Res. Inst.,
Mysore, December 22, 1954.

1. Watt, G., *A Dictionary of the Economic Products of India*, 1899, **1**, 386.
2. Wealth of India, *Raw Materials (C.S.I.R., India)*, 1948, **1**, 154.
3. Yoshimura, K. and Yamashita, I., *J. Agr. Chem. Soc.*, (Japan), 1935, **11**, 355; (*cf. Chem. Abstr.* **26**, 6623).
4. Subramanian, N. and Lakshminarayana Rao, M. V., *J. Sci. Industr. Res.*, 1955, **14C**, 56.
5. Chick, H., et al., *Biochem J.*, 1935, **29**, 1702.
6. Osborne, T. B., et al., *J. Biol. Chem.*, 1919, **37**, 223.
7. Subrahmanyam, V. and Sur, B. K., *Indian J. Med. Res.*, 1949, **37**, 319.

SEPARATION OF SILVER, MERCURIOUS AND LEAD IONS BY CIRCULAR PAPER CHROMATOGRAPHY

EMPLOYING the "ascending" and "descending" techniques of paper chromatography it has been found¹ that nearly 10-15 hours or even more are required to effect the separation of inorganic ions. Circular paper chromatography has been adopted in this laboratory to separate the ions and it has been noticed that the interval of irrigation could be considerably reduced. The following is the outline of the method employed for the separations of silver, mercurous and lead ions.

About 0.05 ml. of the solution containing silver, mercurous and lead nitrates (0.05 M with respect to each salt) is spotted at the centre of a filter disk (Whatman No. 1 or No. 3) about 20 cm. in diameter and allowed to dry for about 30 minutes. The filter disk is then irrigated by solvents as described by Giri and co-workers,² in a closed chamber for about 2-4 hours. The solvent travels about 9 cm. from centre during this interval. The filter disk is then removed, dried at room temperature and sprayed with ammoniacal hydro-

gen sulphide from an all-glass sprayer³ to develop the bands. The R_f value of each band is measured. The individual ions are also subjected to an identical treatment and R_f values are

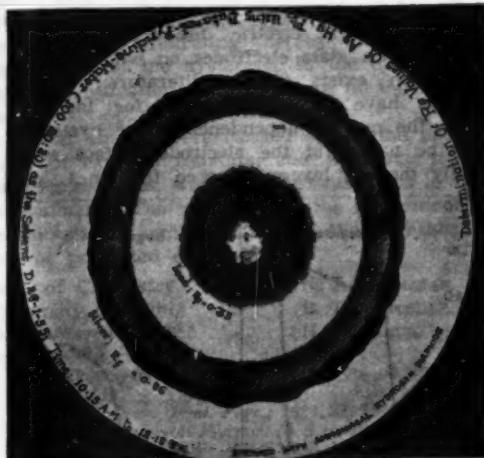


FIG. 1. Determination of R_f values of Ag, Hg, Pb, using Butanol-Pyridine-Water (100 : 20 : 20).

determined for each solvent. It is thus possible to identify the individual ions after the separation. The specific reagents for the

metallic ions have also been used to identify the metals.⁴ Lead, mercury and silver were identified by sodium rhodizonate (blue), diphenyl carbazone (violet), and p-dimethylamino-benzylidene-rhodanine (red-violet) respectively.

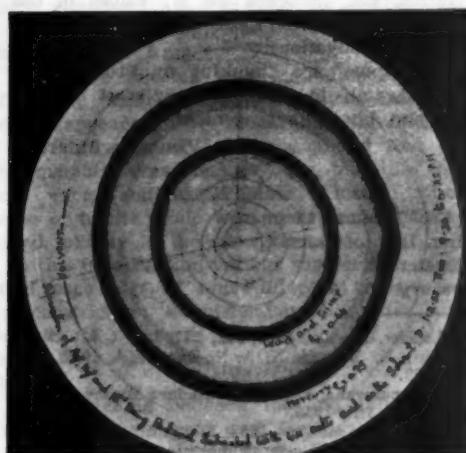


FIG. 2. Separation of Ag, Hg, and Pb using Butanol saturated with 4N acetic acid.

The main features of the results obtained are presented in Table I.

TABLE I

Solvent	Time of irrigation for the solvent to travel 9 cm.	R_f values of metallic ions			Remarks
		Ag ⁺	Hg ⁺	Pb ⁺⁺	
1 Butanol-Pyridine-Water ⁵ 100 20 20	2 hours	0.86	0.62	0.34	Photograph of the chromatogram is given in Fig. 1
		0.87	0.65	0.33	All the three ions get clearly separated
2 Butanol saturated with 4 N acetic acid ⁶	2.25 hours	0.44	0.75	0.48	Photograph of the chromatogram is given in Fig. 2
		0.43	0.77	0.45	Silver and lead travel very close to each other. Mercury moves faster with the solvent
3 Collidine saturated with 0.4 N nitric acid ⁷	3.5 hours	0.97	Very little movement	Both Hg and Pb give a diffused patch which is not clearly moved and separated from the centre	
		0.95		Ag moves practically along with the solvent and can be separated from the other two	

It can be readily seen that butanol pyridine water is a suitable irrigant to separate all the three ions from a mixture containing Ag^+ , Hg^+ , Pb^{++} in solution.

Various factors such as concentration, pH, method of spotting and irrigating, period of irrigation, etc., influence the R_i values of the individual ions. All these factors are under detailed investigations.

The authors are thankful to Prof. K. R. Krishnaswami, for his keen interest in the work and kind encouragement.

A. R. VASUDEVA MURTHY.
V. A. NARAYAN.
M. R. A. RAO.

Dept. of General Chem.,
Indian Inst. of Science,
Bangalore-3,
February 16, 1955.

1. Lederer, *Nature*, 1948, **162**, 777.
2. Giri, K. V. and N. A. N. Rao, *Ibid.*, 1952, **169**, 923.
3. Satyanarayana, S. K. and Vasudeva Murthy, A. R., *Curr. Sci.*, 1955.
4. Feigl, F., *Spot tests*, 1954, Inorganic applications, 4th Ed., I, Elsevier Publication Company, New York.
5. Harasawa, *J. Chem. Soc. Japan*, 1951, **72**, 107, 236, 425.
6. Frierson and Ammons, *Jour. Chem. Edn.*, 1950, **27**, 37.
7. Mcomin, Pollard and Elbeih, *Discussions of the Faraday Soc.*, 1949, **7**, 183.

DEPENDENCE OF HYSTERESIS IN LOW FREQUENCY ELECTRIC DISCHARGE ON ELECTRODE SURFACE

It is known that as the potential applied between the two electrodes of a discharge tube is increased, a value is reached at which the current passing through the system begins to rise abruptly.^{1,2} At this voltage, the medium breaks down as a dielectric and the so-called secondary processes become operative³; it is referred to as the threshold or breakdown potential (V_s). The curve representing the variation of the current i with applied potential (V) is characteristic of the system. Further, as the potential is decreased from above the breakdown voltage to values less than V_s , the current does not follow the former characteristic but instead, a slightly curved path towards the origin⁴ thus resulting in a hysteresis loop (cf. Fig. 1 A). This arises primarily on account of the difference between the breakdown potential V_s and the maintenance potential V_m upto which the enhanced current

could be maintained; usually $V_s > V_m$. The existence of the above hysteresis loops in discharges with alternating fields and metallic electrodes has been well studied by Reich and others.^{4,5} The present note reports an investigation of the hysteresis loops in low frequency (50 cycles/sec.) electric discharge in iodine vapour with glass electrodes on which no information exists in the literature; these studies have further revealed, for the first time, the marked dependence of the hysteresis on the nature of the electrode surface especially the gas layers adsorbed thereon.

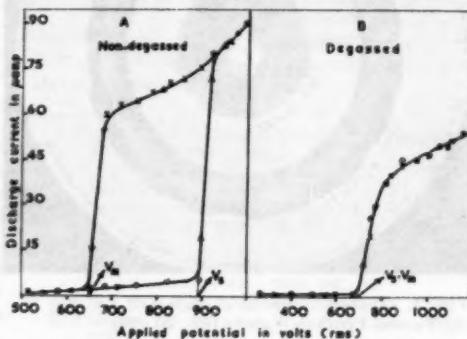


FIG. 1. Potential variation of the discharge current representing the hysteresis in low frequency (50 cycles/sec.) electric discharge in non-degassed (A) and degassed (B) vessels.
Pressure of iodine vapour = 0.44 mm. Hg (30°C.).

Cylindrical glass vessels fitted with external sleeve electrodes, such as those first used by Wiedeman and Ebert,⁶ were employed in the present investigation. Two series of experiments were carried out: in the first series (A), the discharge tubes as prepared from the available glass tubing were evacuated and then filled with pure iodine vapour at a desired pressure; in the other (B), the pre-adsorbed layers of H_2O , etc., commonly held by glass surface⁷ were removed by degassing the vessel, i.e., by heating under vacuum to 200°C. and condensing the gases in a liquid air trap,^{2,8} and then filled (at 30°C.) with iodine vapour at the same pressure as in A. A typical series of results representing the characteristic curves (V vs. i) and the hysteresis loop in A and B are given in Fig. 1. It was interesting to note that the breakdown voltage V_s in a non-degassed vessel, i.e., from which the pre-adsorbed H_2O vapour layers were not removed, was appreciably high; and decreased with degassing the vessel. Thus when the pressure of iodine vapour was 0.44 mm. Hg, V was 910 volts (r.m.s.) in the former case and 700 in the

degassed tube. Further, in the non-degassed vessel there was a marked difference between the breakdown voltage V_b and the maintenance potential V_m thus giving an appreciable hysteresis loop (Fig. 1A). It was remarkable that this last was not noticed in the degassed vessel (Fig. 1B) indicating thereby the marked dependence of the hysteresis, in the discharge under investigation, on the nature of the surface.

Similar studies were carried out in the presence of external radiation and with external circuit resistances, when the hysteresis was less predominant. The details and the theoretical considerations arrived at from these results will be presented elsewhere.

Dept. of Chemistry,
University of Delhi,
Delhi, March 3, 1955.

N. A. RAMAIAH.
B. D. KHOSLA.
H. C. GAUR.

1. Subrahmanyam and Ramalak, *Zeit. f. Physik*, 1954, **138**, 151.
2. Ramaiah, *Jour. Chem. Phys.*, 1954, **22**, 1507.
3. Loeb, *Fundamental Processes in Electric Discharge in Gases*, John Wiley, New York, 1939.
4. Reich, *Theory and Applications of Electron Tubes*, McGraw-Hill Book Co., 1939.
5. Reich and Depp, *J. Applied Phys.*, 1938, **9**, 421.
6. Wiedeman and Ebert, *Wied. Ann.*, 1936, **1**, 221.
7. McBain, *Sorption of Gases on Solids*, Routledge, New York, 1932.
8. Razouk and Salem, *Jour. Phys. and Colloid Chem.*, 1948, **52**, 1208.

PREVENTION OF CHOLINE TOXICITY IN RATS

CHOLINE CHLORIDE has been reported by Hodge¹ to be highly toxic on rats by intraperitoneal route; expressed as mg. per 100 g. body weight the LD₅₀ value is 59-75 for a solution containing 20 mg. per c.c. Lethal dose for several species has been reported to be 40-60 mg. per kg. body weight intravenously.² Halliburton,³ Lohmann,⁴ Chevalier⁵ and Gautrelet,⁶ have shown that choline has a vasodilator effect.

Choline chloride, in a commercial preparation of B Complex (Parenteral) which was used, occurs as 25 mg. per ml. and with 0.5 ml. of it rats died with shock when injected intravenously. The nature of reactions was similar to that as has been described for choline chloride on rats by intraperitoneal route, e.g., death preceded by respiratory paralysis, trembling, convulsive movements, salivation and hemorrhage around the eyes.

The toxicity of choline chloride was confirmed on a number of albino rats in our laboratory and was found that no other member of B vitamins [e.g., thiamine hydrochloride or

mononitrate (B₁), pyridoxine hydrochloride (B₆), riboflavin (B₂), nicotinic acid amide (NAA) and d-pantothenyl alcohol] was toxic to the rat by intravenous route in the quantity as occurs in 0.5 c.c. of the B Complex preparation. Each c.c. of the B Complex preparation used contains: B₁ 25 mg.; B₂ 1.0 mg.; B₆ 2.5 mg.; NAA 50 mg.; choline 25 mg.; pantothenyl alcohol 5 mg.

Rats were injected with individual solutions of all the members in the same concentration which appear in the preparation in dose of 0.5 ml. intravenously and was found that all the members were equally non-toxic in this dose except choline; choline chloride either alone or in the group with other members produced toxicity in the same manner.

In this investigation various supplements were tried especially of four different types, viz., vasoconstrictors, antihistamines, diuretics and detoxicants to see if the toxicity of choline could be counteracted with any of them on rats.

Rats weighing between 150 and 180 g. both male and female were used for the experiment as difference in toxicity in the sex was hardly observed. The various solutions administered on rats were all from sterile vials. As for the choice of various supplements used, consideration was given to the (a) vasodilator property of choline and was tried with several vasoconstrictor substances, such as adrenaline and ephedrine, either alone or in combination; (b) histamine-like responses and was tried with some antihistamines, like phenylbutazone, benadryl, chlortrimetonmaleate; and (c) toxicity in general and was tried with a few known detoxicants,⁷ e.g., methionine and glycine; and diuretics, e.g., sorbitol and urea. Since there was no difference in toxicity in the trials with choline chloride alone or B Complex solution as a whole, all experiments were performed with B Complex solution and various supplements were mixed with B Complex solution.

Choline chloride in dose of 12-13 mg. was found to be lethal to rats by intravenous route. Although choline has been referred to as a vasodilator, nevertheless toxic symptoms did not appear to be due to vasodilation as none of the vasoconstrictors used neutralised the effect. Antihistamines were also equally ineffective in counteracting the toxicity. Amongst the detoxicants it was found that though methionine has been classed as a detoxicant, it did not help in rats; whereas glycine showed pronounced detoxifying action. Results with diuretics, e.g., sorbitol and urea were inconclusive. It was observed that there was no toxic-

city in the alkaline B Complex solution (made alkaline just before injection; pH 8.0).

Res. and Control Lab., B. K. NANDI.
Teddington Chem. Factory, Ltd., D. BANERJEE.
Bombay, November 10, 1954. S. CHOUDHURI.

1. Hodge, H. C., *Proc. Soc. Expt. Biol. Med.*, 1944, **26**, 57.
2. —, *Ibid.*, 1942, **281**, 51.
3. Mott, F. W. and Halliburton, W. D., *Proc. Roy. Soc.*, 1899, **55**, 91.
4. Lohmann, A., *Arch. Physiol.*, 1906, **118**, 215.
5. Desgrez, A. and Chevalier, *J. Comp. Rend.*, 1908, **146**, 89.
6. Gautrelet, J., *Ibid.*, 1909, **148**, 995.
7. Martin, G. J. and Thompson, M. R., *Chemical Abstracts*, 1946, **40**, 3236.

OXYSPORIN, A NEW ANTIBIOTIC FROM *FUSARIUM OXYSPORUM* SCHLECHT

DURING a survey on antibiotic production by species of *Fusarium*, it was observed that a large number of strains of *F. oxysporum* Schlecht, among other species, showed varying levels of activity. Among the sixteen strains tested, seven were found to be active, and strain 549, originally obtained from the Ministry of Agriculture, Government of the Republic of Argentina, exhibited maximum antibiotic action.

Subsequent isolation, and examination of the properties,—chemical and biological,—of the anti-bacterial substance revealed that it did not resemble any of those compounds previously isolated from this species. The term "oxysporin" has, therefore, been employed to designate this new antibiotic.

The production of antibiotics by strains of *F. oxysporum* Schlecht has been found, by Gäumann and associates,¹ and Plattner, Nager and Boller,² to vary with individual strains. It was observed that the various strains of the species produced varying types of antibiotic compounds with different molecular formulae, melting point and other properties, as outlined in Table I.

TABLE I

Antibiotic production by *F. oxysporum* Schlecht

Strain No.	Name of antibiotic	Formula	m.p. °C.	[α] _D in CHCl ₃
ETH 1623	Enniatin-A	C ₂₄ H ₄₂ O ₆ N ₂	121–122	-91.9°
ETH 1574	Enniatin-B	C ₂₅ H ₄₄ O ₆ N ₂	173–175	-107.9°
ETH 1524	Enniatin-C	C ₂₅ H ₄₂ O ₆ N ₂	152–153	-104.4°

-24 -62

Preliminary studies indicate that oxysporin possesses melting point below 70° C. and has very high *in vitro* activity against *M. tuberculosis*. Table II represents the activity of the antibiotic against *Mycobacterium tuberculosis* var. *hominis*, strain H 37 Rv. in Youmans' medium.

TABLE II
Activity of Oxysporin *in vitro* against
Mycobacterium tuberculosis var. *hominis* H 37 Rv

Readings made at the end of	Oxysporin in µg./ml.				
	1000	100	10	1	0.1
1st week	—	—	—	—	—
2nd week	—	—	—	—	++
3rd week	—	—	—	+	++

— total inhibition; + partial inhibition; ++ fail growth.

Preliminary investigations of the *in vivo* activity of this antibiotic in experimental murine tuberculosis have indicated that oxysporin exhibits activity almost equivalent to that of streptomycin. Results of detailed studies on the chemistry and pharmacology of this antibiotic will be reported elsewhere.

Thanks are due to Dr. K. P. Menon for his keen interest in this investigation.

Pharmacology Labs., M. O. TIRUNARAYANAN.
Indian Inst. of Sci., M. S. S. R.
Bangalore-3, February 12, 1955.

1. Gaumann, E., Næf-Roth, S., Ettlinger, L., Plattner, Pl. A. and Nager, U., *Experientia*, 1947, **3**, 202.
2. Plattner, Pl. A., Nager, U. and Boller, A., *Helv. Chim. Acta*, 1948, **31**, 594.

THE ABO BLOOD GROUPS OF KUMAONIS

NUMEROUS anthropological blood groups surveys of various communities have been carried out. These have been tabulated by Boyd and Mourant.²

The blood group distribution of the people of Kumaon (in Uttar Pradesh) does not appear to have been investigated previously.

The distribution of the ABO groups in 111 Kumaoni blood donors was found to be as under:

O	..	27	24.324%
A	..	30	27.027%
B	..	38	34.234%
AB	..	16	14.414%
Total	..	111	99.999%

The gene frequencies calculated by the method of Bernstein³ (1930) are as under :

$$p = 0.23344$$

$$q = 0.28179$$

$$r = 0.48474$$

The percentages of the expected phenotype frequencies, derived from the estimated gene frequencies, and those of the observed phenotype frequencies are compared in Table I.

TABLE I

	Observed	Expected
O	24.324	23.497
A	27.027	28.081
B	34.234	35.260
AB	14.414	13.156
Total	99.990	99.994

χ^2 for testing the goodness of fit is 0.243 for one degree of freedom. The deviation of the observed from the expected values is not statistically significant.

Armed Forces Medical G. W. G. BIRD.
College, Poona, P. KRISHNASWAMY.
January 11, 1955.

1. Boyd, W. C., *Tabul. Biol.*, 1939, 17, 113.
2. Mourant, A. E., *The Distribution of the Human Blood Groups* (Oxford University Press), 1954.
3. Bernstein, F., 1930, cited by Race, R. R. and Sanger, R., *Blood Groups in Man* (Oxford University Press), 1954.

AN ALTERNATIVE CONVENTION FOR pH

SORENSEN¹ introduced the convention of pH such that, $pH = -\log [H^+]$. In this convention, an inconvenient negative number is avoided by changing not only the sign of the characteristic, which is usually negative here, but also that of the mantissa of $\log [H^+]$ which is always positive. Instead, this may be made simpler by avoiding the negative sign of the characteristic alone by adding 14 to it, leaving the mantissa as such. The number 14 is chosen since the characteristic of $\log [H^+]$ rarely exceeds 14 in absolute magnitude and also since it is the absolute magnitude of the exponent of the accepted average value of the ionic product of water at about 25°C.

An alternative convention of L_H for expressing hydrogen-ion concentration is, therefore, suggested, such that

$$L_H = 14 + \log [H^+]$$

This new convention has the following advantages over pH :

1. It is more rational and logical since it expresses the hydrogen-ion concentration in terms of its own logarithm.

2. L_H has a direct relation to H-ion concentration which is much better than the inverse relation between H-ion concentration and pH.

3. Interconversions of $[H^+]$ and L_H are much easier than those of $[H^+]$ and pH, as can readily be seen.

4. The pH of a buffer composed of a weak acid and its salt with a strong base is given by the relation :

$$pH = pK + \log \frac{[Salt]}{[Acid]}$$

A similar relation can be derived for the L_H of the same buffer, viz.,

$$L_H = L_K + \log \frac{[Acid]}{[Salt]}$$

From the above equations it can be seen that, for a given concentration of salt, as the concentration of the acid increases, the L_H of the buffer increases whereas its pH decreases. This again is a direct relation, with its added advantage and simpler mode of calculation, compared with the inverse relation in case of pH.

5. Starting from the ionic product of water, i.e., $[H^+] [OH^-] = 10^{-14}$ (on average), it can be shown that

$$pH = -\log [H^+] = 14 + \log [OH^-]$$

Thus, in expressing $[H^+]$ in terms of pH, we are actually expressing it in terms of $[OH^-]$ or of $\log [OH^-]$ adding 14 to it, while by adding the same 14 to $\log [H^+]$ and expressing it as L_H a more elegant method of expressing H-ion concentration is obtained.

It may be remarked that this addition of 14 to a logarithm to make it positive and convenient, is nothing unusual. Such a practice has long been adopted by mathematicians in adding 10 to the logarithm of sine and of cosine, to avoid their negative characteristics.

The changing over from pH to L_H need not present any difficulty to text-book writers and other authors, because of the simple relation :

$$L_H = 14 - pH$$

Hence, the pH values of buffer tables can easily be changed to L_H values by substituting $(14 - pH)$ as L_H , without changing the composition of the buffer.

To avoid any typographical difficulties in printing, "eH" (meaning: 'enhanced or enlarged exponent of $[H^+]$ '), may be used instead of L_H .

Further details will be published elsewhere.
Pharmaceutics Dept., K. S. MURTY.
Madras Medical College,
Madras, February 8, 1955.

1. Sorenson, S. P. L., *Biochem. Zeitschr.*, 1900, 21, 131.

OSTEOLOGY OF CATFISHES

TATE REGAN¹ in his classification of the Ostariophysci remarked that the order included a number of genera which varied in form and appearance but uniformly possessed the remarkable Weberian apparatus. Siluroids form a large bulk of the order Ostariophysci including 28 families (Berg²). These have undergone many interesting modifications in various directions. The gas-bladder is modified to suit air-breathing habits and the Weberian apparatus is closely connected with this. Bridge and Haddon³ stated : "It is remarkable that this important group of fishes have so little occupied the attention of morphologists, especially when we take into consideration the interesting modifications which its various members have undergone.....". Very little work has been done on the osteology of catfishes in India with a view to assessing its usefulness in systematics. No work has been done on the development of skull in any Indian catfish. Kindred⁴ however, has studied the development of skull of an American form, *Amiurus*. An account of the adult morphology of the skull in a few Indian catfishes is given by Bhimachar² and in *Eutropiichthys* by Kumar.⁵

Representatives of six families, viz., Siluridae, Bagridae, Amblycipitidae, Akysidae, Sisoridae and Olyridae have been selected for the study of adult cranial morphology. In addition, the development of the chondrocranium is being studied in *Silonia*, *Pangasius* and *Ailia* (Family : Schilbeidae), in order to find out if these studies help in tracing their inter-relationships.

The chondrocranium of *Silonia* (2 mm. head-length) exhibits a few interesting features. The roofing cartilages are absent and the hypophysial fenestra is spacious, extending from the ethmoid plate to the basal plate.

In the visceral arches, the pterygoid cartilage arises independently and articulates anteriorly with the ethmoid region. The quadrate is fused with hyomandibular cartilage as in other catfishes described. This peculiar feature is also noticed in a few other fishes like *Clupea* (Wells⁶) and *Ophicephalus* (Srinivasachar⁷). It is difficult to understand the significance of this fusion.

Normally in the teleosts, the upper jaw of the adult shows a methyostylic suspension and this is also seen in the siluroids I have examined. But in the case of one genus studied, *Batasio* (Family : Bagridae) the pterygoid of the upper jaw gains an articulation with the orbito-sphenoid bone by an articular facet, in

addition to the usual hyomandibular articulation in the otic region. This is an unusual feature. Additional articulation of the entopterygoid of the upper jaw with the pre-vomer bone has been reported by Ramaswami in *Pseudorasbora*, a cyprinid fish.

A complete account of the chondrocranium and osteocranum of the above forms will be published elsewhere.

I am grateful to Dr. L. S. Ramaswami for guidance, to Prof. B. R. Seshachar for his helpful criticisms and to Dr. S. L. Hora for encouragement.

Dept. of Zoology, H. R. SRINIVASACHAR.⁸
Central College, Bangalore,
February 8, 1955.

* Junior Fellow, National Institute of Sciences.

1. Berg, L. S., *Classification of Fishes, both Recent and Fossil*, (English Translation: J. W. Edwards, Michigan), 1947.

2. Bhimachar, B. S., *Half-yearly J. Myt. Uni.*, 1933, 7, 233.

3. Bridge, T. W. and Haddon, A. C., *Phil. Trans. Roy. Soc.*, 1889, 46, 309.

4. Kindred, J. E., *Illinois Biol. Monographs*, 1919, 5, 1.

5. Kumar, A., *Curr. Sci.*, 1955, 24, 17.

6. Ramaswami, L. S., *Science*, 1953, 118, 357.

7. Regan, C. T., *Ann. Mag. Nat. Hist.*, 1911, 8, 553.

8. Srinivasachar, H. R., *J. Linn. Soc. Lond.*, 1953, 42, 238.

9. Wells, F. R., *Proc. Zool. Soc. Lond.*, 1922, 1213.

ABNORMALITIES IN THE FLOWERS OF *DOLICHOS LABLAB, VULGARIS* SAVI.

SEVERAL abnormalities observed in the flowers of *Dolichos lablab, vulgaris* Savi. at Pilani are briefly recorded below:

PETALS.—(1) In addition to the normal posterior standard, another standard had developed; (2) Some showed three wings; some others showed two free keels laterally towards the sides while the anterior side was occupied by a sixth petal in some others; (3) Seven petals were found in some flowers, one standard, two wings and one normal keel, while the three others were more resembling wings.

STAMENS.—In the staminal whorl a number of abnormalities were noted. Instead of the ten normal stamens in two bundles of one and nine, twelve stamens were found in a number of cases. Two posterior stamens were found to be fused with the standard, the balance ten being disposed of in two bundles with varying numbers in each ($5+5+2$, $8+2+2$, $11+1$, $5+5+1$). In one flower the posterior stamen was converted into a petaloid staminode

of extra big size and the rest were in two bundles of five each. In one of the bundles of five, a half anther alone was transformed into a petaloid staminode. There were also a few cases where two stamens had fused and the two anthers were found on the same filament. In one odd case the filament had become flat and petaloid bearing two anthers one on each side.

PISTIL.—The gynoecium was found to be composed, in a number of cases, of two and three carpels which were either free or united either completely or by the basal portions of the ovaries only leaving the styles and stigmas free. In a few cases the carpels were found to be open with the ovules visible outside partially. In one case the ovules were definitely located outside the open carpels. However, none of these polycarpellary gynoecia developed into fruits. Microtome sections of the ovules from such gynoecia showed that the embryo sac had developed; but the contents were found to disorganise as the ovules progress in their development. Artificial pollination with self- and cross-pollen was also tried, but with no effect.

The author is indebted to Dr. B. N. Mulay, for valuable help.

Dept. of Botany,
Birla College of Science,
Pilani, Rajasthan,
November 10, 1954.

S. K. PILLAI.

ON THE NATURE OF PRIMARY VASCULAR TISSUE IN THE TENDRIL OF *VITIS PALIDA* W. & A.

So far as the writer is aware no study has been made of the nature of primary growth in the tendril of *Vitis*. Some observations made on *Vitis pallida* W. & A. indicate that there are about 23 primary xylem groups. The secondary xylem at the basal portion is in the form of radiating strands of xylem fibres and a small number of vessels, alternating with the broad parenchymatous xylem rays which give a characteristic lamellate appearance similar to that of the stem (Metcalfe and Chalk¹). But this pattern of secondary growth may not be observed in the other part of the tendril. In a young tendril in which primary growth has not been completed, the vascular meristem appears to consist of 7-8 procambial strands arranged in a ring-like manner. They are connected to one another by strips of the residual meristem. Some of the cells of residual meristem divide tangentially and form additional smaller vascular bundles among the large ones and the protophloem and proto-

xylem cells may develop simultaneously. But sometimes only a single or more tracheary elements are first observed in the initial development of such a vascular bundle. Later a typical cambium was observed. Obviously the interfascicular part of the cambium ring has developed from differentiated residual meristem cells. According to Mclean and Cook,² the residual meristem in *Vitis* forms parenchyma cells which later give rise to the interfascicular cambium.

The question arises as to whether the vascular bundles developed from the residual meristem are primary or secondary. They are described here as primary because the structure of the cambium and residual meristem cells which give rise to the smaller vascular bundles is different. Though it should be noted that the residual meristem shows cambium-like behaviour and the primary vascular tissues formed from it are also arranged in a radial manner. But these features are not always a sound criterion for delimiting secondary from primary tissues (Esau³). Therefore the later-formed smaller vascular bundles can be said to be formed by delayed or prolonged primary growth.

I am grateful to Prof. Maheshwari for suggesting the problem and kind interest.

Dept. of Biology,
M.T.B. College, Surat,
October 5, 1954.

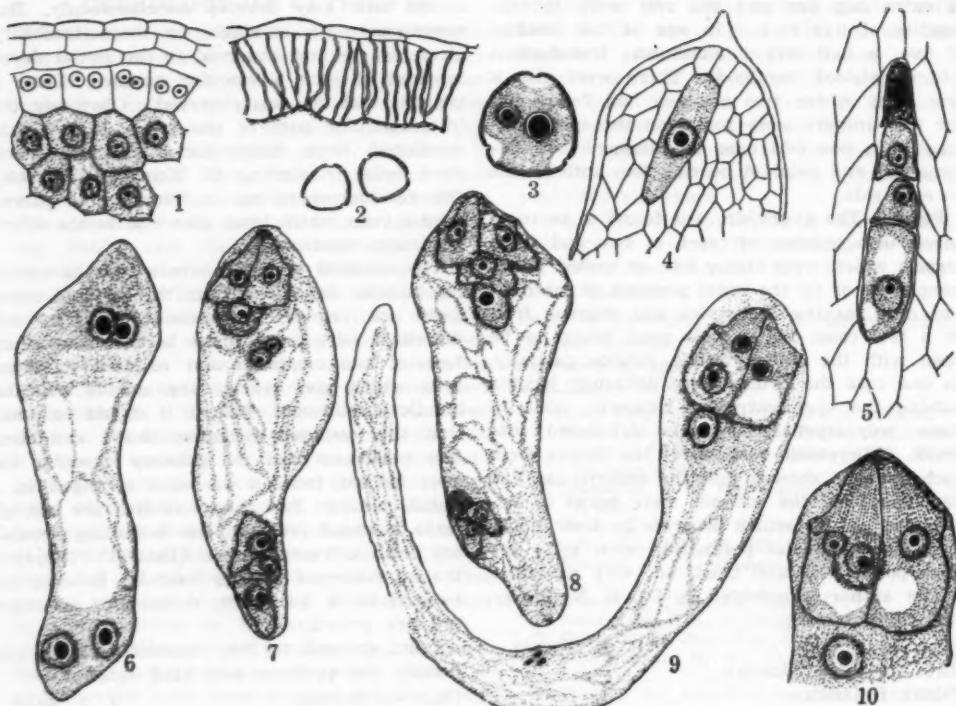
J. J. SHAH.

1. Metcalfe and Chalk, *Anatomy of the Dicotyledons*, 1950, I, 415, Clarendon Press, Oxford.
2. Mclean and Cook, *Text-book of Theoretical Botany*, 1951, 856, Longmans, London.
3. Esau, K., *Bot. Rev.*, 1943, 9, 125.

A CONTRIBUTION TO THE EMBRYOLOGY OF *OPILIA* *AMENTACEA* ROXB.

Opilia amentacea Roxb., belonging to the parasitic Opiiliaceæ, displays certain interesting features in its mode of life, floral structure and reproduction showing similarities with the allied families of the order Santalales.

The floral parts arise in acropetal succession. The young anther wall is composed of three layers external to the tapetum (Fig. 1). The tapetal cells are binucleate and are of the glandular type. The endothecium develops fibrillar thickenings (Fig. 2). The microspore mother cells after undergoing meiotic divisions give rise to microspores which are arranged tetrahedrally. The tricolpate pollen grain is two-celled at the time of shedding (Fig. 3).



FIGS. 1-10

FIG. 1. Portion of anther lobe showing epidermis, endothecium, middle layer, binucleate tapetum and sporogenous cells, $\times 250$. Fig. 2. Portion of anther wall showing fibrillar endothecium, $\times 250$. Fig. 3. Mature pollen grain, $\times 500$. Fig. 4. L. s. ovule showing archesporial cell, $\times 250$. Fig. 5. Linear tetrad of megasporangia, $\times 375$. Fig. 6. Four-nucleate embryo sac, $\times 375$. Fig. 7. Young embryo sac, $\times 250$. Fig. 8. Lower end of the embryo sac elongating leaving the antipodal cells *in situ*, $\times 250$. Fig. 9. Mature embryo sac, $\times 250$. Fig. 10. Egg apparatus showing filiform apparatus in synergids, $\times 375$.

The ovary is unilocular, superior and is surrounded by a hypogynous disc which has five prominent fleshy club-shaped glands. As in Santalaceae the gynoecium in this member conforms to the paracarpous type. A mound of tissue arises from the base of the ovary to form the mamelon, which, as development proceeds, produces a downward facing ovule projecting into the ovarian cavity. While generally a single ovule develops, occasionally two pendulous ovules are seen projecting into the ovary cavity on either side of the mamelon. The ovules do not show any differentiation into nucellus and integument. There is, therefore, nothing which can be designated as the micropyle. However, the side towards which the megasporangium differentiates is considered micropylar, while the term chalazal is used in the same sense as basal.

A single hypodermal archesporial initial (Fig. 4) gives rise to a deep-seated megasporangium which undergoes the usual meiotic divisions to form a linear tetrad of megasporangia (Fig. 5). The chalazal megasporangium develops further, while the other three degenerate. The development of the female gametophyte conforms to the Polygonum type (Figs. 5-7). The morphological upper end of the embryo sac enlarges while the lower end narrows and elongates. The eight-nucleate embryo sac is oval, and remains intraovular for some time but subsequently the lower end of the embryo sac begins to grow further leaving the antipodal cells *in situ* (Fig. 8). Then it takes a bend and grows down making its way through the central column and developing into a prominent haustorium (Fig. 9). Thus the embryo sac in its fully grown condition assumes an

inverted U shape bearing a very close resemblance to that seen in *Thesium wightianum* (Rao¹). The synergids are slightly hooked and exhibit filiform apparatus. The egg hangs down below the synergids. The secondary nucleus becomes associated close to the egg (Fig. 10).

My grateful thanks are due to Profs. L. N. Rao and C. V. Krishna Iyengar for their valuable help.

Dept. of Botany,
Central College, Bangalore,
March 7, 1955.

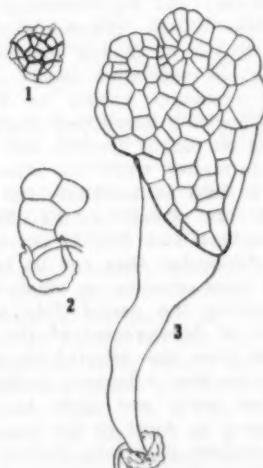
S. SHAMANNA.

1. Rao, L. N., *Ann. Bot. N. S.*, 1942, 6, 151.

SPORELING GERMINATION STUDIES IN *CRYPTOMITRIUM HIMALAYENSIS* KASH.

Cryptomitrium himalayensis Kash. is monocious with thalli yellowish green, delicate; antheridia borne in the mid-dorsal groove just behind the stalk of the female receptacle; and met with in the moist, often dark places in caves, in North-Western Himalayas at an altitude of 5,000-7,000'. The ripe spores were collected on September 28, 1948, and during September 1949 from Mussoorie and germinated as on a previous occasion.¹

The spores are spherical, light brown, with a triradiate mark, reticulate exine (2-4 reticulations in a diameter), with a perisporium (Fig. 1) and 50-75 μ in diameter. They germinate readily within a week and rupture at the



FIGS. 1-3. Some stages in germination of *Cryptomitrium himalayensis*.

triradiate mark to liberate the germ papilla which has already developed chloroplasts and a few oil globules. The germ cell undergoes a lateral or basal transverse division and the cell thus formed elongates to form the first rhizoid which is thus separated from the mother cell by a definite wall. The rhizoid, sometimes late in development usually contains a few degenerating chloroplasts. The germ tube formation is a common feature. Rarely 3 germ tubes may be formed from a germ cell as in *Plagiochasma*,¹ *Targionia* and *Athalamia*.

The growth, development and behaviour of the germ tube resembles that of other Rebouliaceæ¹ but the early stages are variable. Formation of a vertical wall in the terminal cell (Fig. 2) initiates disc formation, either immediately or after elongation of the germ tube. The latter is caused by unfavourable illumination.

The germ disc when mature is more or less inclined at an angle 30-40° on the germ tube axis. The elongated germ disc becomes two-layered even at a younger stage. It grows for some time by the apical marginal meristem, later replaced by a tetrahedral apical cell, lodged within the apical notch. In this disc later the apical region, due to more layer formation, becomes prominent and slightly raised up from the surface of the basal region of the sporeling (Fig. 3). This demarcation becomes prominent due to the development of anthocyanin pigment in some of the marginal cells of the thallus (and also in the basal cells of this ascending region). Gradually the basal region decays at the expense of the apical region which directly passes into the main thallus, thus greatly reducing the time from germination to thallus development. The effects of weak illumination and excessive moisture are same as described for other Rebouliaceæ.

It is thus evident that in Rebouliaceæ the formation of germ disc is either of Reboulia type or of Asterella type. The development in *Cryptomitrium* is more or less inclined towards the Asterella plan.

I am grateful to Profs. P. N. Mehra and W. C. Steere for encouragement.

Malaria Res. Lab.,

P. KACHROO.

D. V. C., Burdwan,

December 28, 1954.

1. Mehra, P. N. and Kachroo, P., *The Bryologist*, 1951, 54, 1-16.

**AN UNDESCRIBED SPECIES OF
PROTOMYCOPIST ON CROTALARIA
TRIQUETRA DALZ.**

ON leaves of *Crotalaria triquetra* Dalz., black spotting incited by a species of *Protomycopsis* was noticed near Mount Abu in September 1953. The spots were mostly confined to the lower leaves, first appearing as light yellow specks, gradually enlarging and turning black. On mature leaves the spots were 2-7 mm. in diameter, often coalescing to form larger patches.

Microscopic examination of the infection spots revealed the presence of intercellular hyphae and numerous dark reddish brown resting spores densely interspersed in the intercellular spaces. Mature spores measure 16-24 μ in diameter with mean of 19 μ , and possess thick warty wall characteristic of the genus *Protomycopsis*.

Comparative studies have indicated that the species under study is undescribed, and comes close to *Protomycopsis patellii* Pavgi, and Thirumal recorded from India on *Phaseolus radiatus* L.¹ The latter species has larger resting spores (22.5-32.5 μ) as compared with 16-26 μ) than the fungus under study. The name *Protomycopsis crotalariae* is proposed for its accommodation.

Protomycopsis crotalariae Joshi Sp. Nov. infection spots circular, 2-7 mm. in diameter, black, often coalescent with each other. Resting spores embedded in mesophyll, aggregated in groups, dark reddish brown, 16-26 μ in diameter with a mean of 19 μ , irregularly globoid, thick-walled, rugose (Fig. 1).

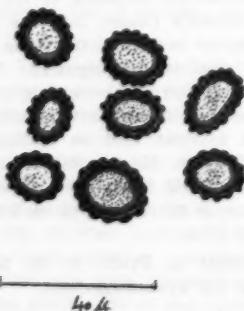


FIG. 1

Maculae circulares, 2-7 mm. in diameter, nigrae, ssepe confluentes. Spore quiscentes in mesophyllo evoluta, plus minusve aggregatae, irregulariter globosae, atro-brunneae, 16-26 μ in diameter in medio 19 μ episporio crassiusculo, rugoso.

Hab. in foliis vivis *Crotalaria triquetra* Dalz.

Mount Abu, Sept. 1953, leg. N. C. Joshi (Type) deposited in Herb. Crypt. Ind. Orient. New Delhi, and Herb. C.M.I., Kew, England.

I am grateful to Dr. M. J. Thirumalachar for his invaluable help in the identification of the fungus, to Mr. M. B. Raizada of F.R.I., Dehra Dun, for the identification of the plant, and to Prof. B. Tiagi and Principal V. V. John for encouragement.

Dept. of Botany,
Govt. College, Ajmer,
January 22, 1955.

N. C. JOSHI.

1. Pavgi, M. S. and Thirumalachar, M. J., *Nature*, 1953, 172, 314.

**MALFORMATION DISEASE OF MANGO
(*MANGIFERA INDICA LINN.*)**

A MALFORMATION disease of mango shoots, particularly of the inflorescence has recently become very serious.¹⁻⁴

The cause of the disease has not been traced so far. Sattar⁵ considers it to be a malady either of a virus or of a physiological nature. According to Sharma⁶ it is neither of fungoid, bacterial nor virus origin. Tripathi⁷ observed that malformation diseases of vegetative shoots and inflorescences are highly correlated and appear to be one and the same. Recently, Narasimhan⁸ found a species of *Eriophyes* causing malformation in mango inflorescences only.

The present author has, however, observed two more species of mites *Tyrophagus castellani* Hirst (Acaridae) and *Typhlodromus* sp. probably *asiaticus* Evans (Phytoseiidae) causing the malformation of mango inflorescences as well as that of vegetative shoots. The first species is commonly known as 'Copra itch mite' which feeds on stored food products, probably feeding on fungus growths and decomposing vegetable matter, while the other may feed on fungus or may be predatory on the first.

The mites are present on the affected trees in large numbers from July to October. During middle of September they can be seen with a magnifying glass crawling on otherwise healthy leaves. During the period July to October, every stage of development of the mites can be obtained from the affected shoots. When winter sets in, they hibernate under the folds of the dried scales and again become active from February to April of the year following. During May-June they take shelter under the dried malformed inflorescences and bunched shoots. Eggs and larvae may also be obtained during these periods on young trees which bear off-season inflorescences. After October,

mostly the larvae are obtained from the malformed vegetative shoots of the tree, whereas the adults are rarely observed. During November-December, most of the young saplings raised for stocks make new growth. These may be affected by the mites.

The full-grown mites are 0.3 mm. in length. Eggs are laid singly under the folds of dried scales and are protected with a webby material by means of which they stick to the scales. The size of an egg is 0.1 mm. and it is typically oval and pearly white. During the warmer season they hatch out in 2-3 days and the nymphs crawl all over the affected shoots. Adult mites are white to pale white in colour.

Application of sulphur dust against the malformation of mango inflorescences did not check the disease. Affected shoots were pruned and 2% tar oil wash (ovicide of I.C.I.) was sprayed on these trees, but did not prove effective.

The author expresses his grateful thanks to Dr. L. B. Singh, for providing facilities for this work and to the Director, Commonwealth Institute of Entomology, London, for identifying the mites.

Govt. Fruit Res. Station, S. M. SINGH.
Saharanpur, January 7, 1955.

1. Burns, W., *Poona Agri. Col. Magazine*, 1910, **2**, 38-39.
2. Lal Singh, S. S. S., Bajwa, S. Bal, and Khan, A. A., *Punjab Fruit J.*, 1940, **4**, 13, 678.
3. Singh, B. N. Chakravarty, *Science and Culture*, 1935, **1**, 294.
4. Nirwan, R. P. S., *Ibid.*, 1953, **18**, 335.
5. Sattar, A., *Punjab Fruit J.*, 1946, **10**, 37-58.
6. Sharma, B. B., *Proceedings of the Fortieth Indian Science Congress*, Pt. III (Abstracts), 1953, 70 and 71.
7. Tripathi, R. D., *Indian J. Horti.*, 1954, **11**, 4.
8. Narasimhan, M. J., *Curr. Sci.*, 1954, **23** (9), 297.

OCCURRENCE OF DOUBLE FLOWERS AND POLYCARPY IN THE GENUS CICER LINN.

At Government Research Farm, Kanpur, four strains of gram are characterised by having double flowers on one peduncle. These strains are No. 159, NP 82, No. 188 and No. 333, strains 159, 188 and 333 being hybrid selection from crosses where one parent was NP 82 (a double flowered strain itself). As a rule there is one axillary flower in the axil of a leaf on one pedicel. In these double-flowered strains, paired peduncles, each with one flower, appear on one pedicel in the very axil. In rare cases, in these double-flowered strains, as an abnor-

mality three flowers in the aforesaid fashion are borne in one axil.

One flower of the double-flowered pedicel, and generally the younger one, is abnormal. Accessory and essential floral parts in these abnormal flowers are often in excess to the general number of these parts. Sepals are from 5-9, petals from 5-7, stamens from 10-17, and carpels from 1-5.

Petals expose the sexual organs of the flowers very early, as soon as they come out of the calyx tube. The more striking phenomenon is sepaloidy of the petals and transformation of essential floral parts into branched shoots in some cases.

Stamens in these flowers are always in polyadelphous condition and very often epipetalous stamens are met with.

Carpels exhibit various interesting forms which may be enumerated as below:

(i) Monocarpellary ovary: (a) stigma single terminal; (b) stigma bifid. (ii) (a) Bicarpellary apocarpous; (b) bicarpellary, both the carpels fused at the base but free above. (iii) Tricarpellary ovary: (a) two carpels as in (ii) (b) and one alone; (b) all the three separate. (iv) Tetracarpellary ovary: (a) 4 separate carpels; (b) 4 forming two pairs and each pair representing the condition as in (ii) (b); (c) 3 having single stigma but the fourth one having bifid stigma. (v) Pentacarpellary apocarpous ovary. (vi) Sometimes pedicels of two or more flowers fuse together and give the flower an appearance of polycarpy. Here the inflorescence looks like a corymb.

It is an interesting case of polycarpy in the genus Cicer. It suggests and supports the theory that highly evolved forms of Rosales represent reduction in the number of carpels and attainment of zygomorphy. The presence of multicarpellary ovaries, conversion of floral parts into stamens and polyadelphous condition of stamens are cases of 'reversion' in the genus. More than one carpel have been observed in the other subfamily Cæsalpinioidy, *Poinciana regia* Boj. (Joshi¹).

In these double-flowered strains which have one flower of the pair abnormal, grain-setting studies were made. It was observed that the abnormal flower of the pedicel does not set pod invariably.

In exceptional cases where the pedicel bears two or sometimes even three normal flowers setting in all the two or three flowers (as the case may be) takes place and double or triple pods in the axil are seen accordingly.

Examination of the pollen grains in these abnormal flowers reveals that 90-95% of the pollen are viable as judged by acetocarmine stain method.

Govt. Res. Farm,

Kanpur, January 31, 1955.

S. P. SINGH.

T. R. MEHTA.

1. Joshi, A. C., *Curr. Sci.*, 1923, 1, 104.

PHOTOPERIODIC RESPONSE IN TIL (*SESAMUM INDICUM LINN.*)

THE effect of short photoperiods on the acceleration of flowering in different varieties of sesamum has been reported previously.¹⁻³ The present note reports the effect of short photoperiods of varying durations on seedlings of two pure strains of deshi til, Jinardi and Goghat, early and medium-late, having black and brown seed respectively. Seeds of Goghat and Jinardi were sown in earthenware pots (12" × 11") on March 10 and May 1, 1950 respectively with three replicates for each treatment. After ten days of sowing, the pots were thinned, keeping only the best four uniform plants in each treatment, and then short photoperiods of 7 and 9 hours for 4, 5 and 6 weeks' duration were applied. The seedlings receiving short photoperiods of 7 and 9 hours were exposed to the sun from 7 a.m. to 2 p.m. and 4 p.m. respectively, and for the rest of the day and night they were kept in a well-ventilated dark room. The control seedlings of each variety were left to grow all through their life-period in the natural day length. The results of the experiment presented in Table I are found to be significant at 1% level, except the number of capsules in Goghat which is not statistically significant.

TABLE I

Variety	Treatment*	Days from sowing to flowering	Number of leaf pairs at first flowering time	Height in cm. at flowering time	Number of branches	Number of capsules
JINARDI	A	40.7	9.9	51.3	9.2	14.6
	B	34.5	7.1	37.4	5.2	12.7
	C	34.0	7.1	39.7	5.4	11.0
	D	30.4	7.1	34.9	7.4	20.5
C.D. at 5% level		1.69	0.23	5.6	1.98	3.83
GOGHAT	A	63.9	11.1	43.0	11.4	26.5
	B	39.2	4.9	15.8	6.4	38.8
	C	39.2	4.4	15.1	6.0	44.8
	D	40.7	5.7	15.2	6.9	40.2
C.D. at 5% level		9.11	1.5	5.3	2.12	21.62

* A—control; B—7-hour day for 4 weeks; C—7-hour day for 5 weeks; D—9-hour day for 6 weeks.

The results show that the short photoperiods induce acceleration of flowering of the main shoot as well as the branches indicating that the whole plant is affected by the treatment. With acceleration of flowering by short days there occurs a reduction in vegetative growth as indicated by the plant height, number of branches and leaf number. Marked decrease in vegetative growth is noticed in the medium-late variety, Goghat, where the effect of short photoperiods is more pronounced than in the early variety, Jinardi. Like paddy,⁴ in sesamum also there exists positive and significant correlation between leaf number and the time of flower formation. Analyses of co-variance of both the varieties were calculated, and it was found that there was a good correlation between the leaf number and the days of flowering from sowing.

It is interesting to note that the shape and size of the leaves of both the varieties have been changed by short photoperiods. The leaves of the control plants are much bigger with middle leaves serrated and lobed trifoliately, while those of the treated ones are entire showing no trifoliate nature. Sen Gupta and Payne⁵ have reported that short photoperiods have very little effect on leaf shape, while long photoperiods and different sowing times cause different shapes of leaves with serration and various degrees of split margins in two varieties of sesamum, I.P.-29 and I.P.-7, marked variation being noticed in I.P.-29 when treated with long photoperiods. Regarding the number of capsules, short days increase the number in both the varieties.

State Agric. Res. Station, B. N. GHOSH,
Chinsurah, Hooghly, January 6, 1955.

- Rhind, D., *Indian J. Agri. Sci.*, 1935, 5, 729.
- Sen Gupta, J. C. and Sen, N. K., *Science and Culture*, 1947, 13, 203.
- Sen, N. K. and Pain, S. K., *Proc. Nat. Inst. Sci. (India)*, 1948, 14, 407.
- Sircar, S. M. and Ghosh, B. N., *Ibid.*, 1954, 20, 452.
- Sen Gupta, J. C. and Payne, S. K., *Nature*, 1947, 160, 510.

LINKAGE OF "PALE GREEN LEAF" WITH "CURLED LEAF" IN *G. HERBACEUM*

GENETIC investigations of the Curled Leaf Mutant¹ are in progress at the Agricultural Research Station, Surat. This mutant gene appears to be identical with that for Curly Leaf reported by Yu² as is indicated by its 17% recombination with the gene for leaf shape. The cross effected between Curled Leaf

TABLE I

	Normal		Curled		Total	χ^2		$\chi^2 L$	P	
	Green Leaf	Pale Green Leaf	Green Leaf	Pale Green Leaf		Normal/Curled	Green/Pale Green Leaf			
A*	..	153	60	72	6	300	0.16 0.00 .. 0.09 17.28 34.11	0.5-0.7 Very high < .001 0.5-0.7 0.7-0.8 < 0.001
B*	..	197	92	96	3	390	0.17
					Total	0.33	0.09	51.39	..	
Total	..	350	161	170	9	690	0.33 .. ..	.. 0.05 ..	0.5-0.7 0.8-0.9 < 0.001
					X ² for homogeneity	Nil .. ..	.. 0.04 ..	.. .. 0.53	> 0.99 0.8-0.9 0.3-0.5

* A—Cross-Pale Green Leaf \times 2087 Curled ; B—Cross-Pale Green Leaf \times 1027 Curled.

found in both 2087 and 1027-A.L.F. varieties and the Pale Green Leaf Mutant³ has revealed that the genes governing the two mutant characters are located on the same chromosome. The F₁ was normal, green. The F₂ segregation was as in Table I.

The R.P. determined by the maximum likelihood method is 22.5. With the discovery of this relationship, the gene for the Pale Green Leaf is included in the linkage group, consisting of the genes for (1) leaf shape, (2) lint colour, (3) curled leaf, and (4) lintless (lid). The position of Curled Leaf and Pale Green Leaf in relation to the other three genes, however, remains to be determined.

Agric. Res. Station,
Surat, January 3, 1955.

N. R. BHAT.
N. D. DESAL

1. Bhat, N. R. and Khattar, K. D., *Curr. Sci.*, 1953, 22, 347.
2. Govande, G. K., *Ind. J. Genet. and Plant Breeding*, 1948, 8, 72.
3. Patel, G. B., Munshi, Z. A. and Patel, C. T., *Proc. Third Cotton Grow. Prob. in India*, 1947, 87-96.
4. Yu, Chi. Pao., *J. Genet.*, 1939, 39, 69.

SOMATIC CHROMOSOMES OF *ANTHERICUM VARIEGATUM* HORT. EX FL.

Anthericum variegatum Hort. ex Fl. is an introduced plant, native of Europe, America, tropical and subtropical Africa. It is a rhizomatous plant, propagated by division from offsets.

A number of metaphase figures were observed in the roots of *Anthericum variegatum*, Hort. ex. Fl., while studying the ontogeny of velamen. The basic numbers of the genus are known to be 7 and 8. The species in which chromosome number is known so far¹ are as given in Table I.

TABLE I

Name of the species	Chromosome number ($2n$)	Locality
<i>Anthericum ciliatum</i>	14	Venezuela
<i>A. roseum</i>	32	"
<i>A. ramosum</i>	32	Europe
<i>A. liliago</i>	64	Europe and North Africa

The chromosome number of *A. variegatum* is being recorded for the first time. A number of metaphase polar view drawings showed that the chromosomes are 24 ($2n$) (Fig. 1). The chromosomes can be roughly arranged in 12 pairs (Fig. 2). One pair is dissimilar. Three pairs have submedian fibre-attachment constrictions, five pairs may be roughly described as having subterminal fibre arrangement constriction and three pairs median fibre attachment constriction. The number 24 ($2n$) tallies with the basic number 8 and it seems this species is a triploid.

Further work is in progress and will be published elsewhere.



FIG. 1

x 950



FIG. 2

My sincere thanks are due to Dr. E. N. Mulay, for his encouragement and guidance.

Dept. of Botany, B. D. DESHPANDE.
Birla College of Science, Pilani,
November 20, 1954.

1. Darlington, C. D. and Annal, Janaki, E. K., *Chromosome Atlas of Cultivated Plants*. George Allen & Unwin, 1945.

STRUCTURE AND DEVELOPMENT OF NUTMEG SEED

VOIGT¹ observed in 1888 that the ruminate endosperm in *Myristica fragrans* is formed by the infoldings of the inner integument. Since then no detailed study of the structure of the nutmeg seed has been made. With a view to elucidating the structure of the seed of *Myristica fragrans* Von. Houtt. or nutmeg, a detailed study of the structure and development of the ovule and seed of nutmeg was taken up and the results obtained are briefly recorded in this note.

The ovule is anatropous, bitegmic and crassinucellate. The micropyle is formed by the inner integument alone, which grows beyond the outer (Fig. 1). It is closely appressed to the latter on one side and to the nucellus on the other, but all the three structures remain distinct from each other right up to the chalaza. In older ovules, however, the line of demarcation between the nucellus and the inner integument becomes difficult to distinguish especially in the chalazal region, and this may even lead to the erroneous idea that the lower part of the ovule is formed by the upward extension of the chalaza. In young seeds the two integuments are wide apart from one another in the micropylar region, leaving a space in between (Fig. 2). Each integument is 4 or 5 layers in thickness (Fig. 1). The embryo sac is formed according to the *Polygonum* type of development. It becomes elongated in form and crushes the nucellus except for about 4 layers at the micropylar end. A postament is formed at the antipodal end. Even before fertilization the outer integument begins to proliferate at the micropylar region and eventually

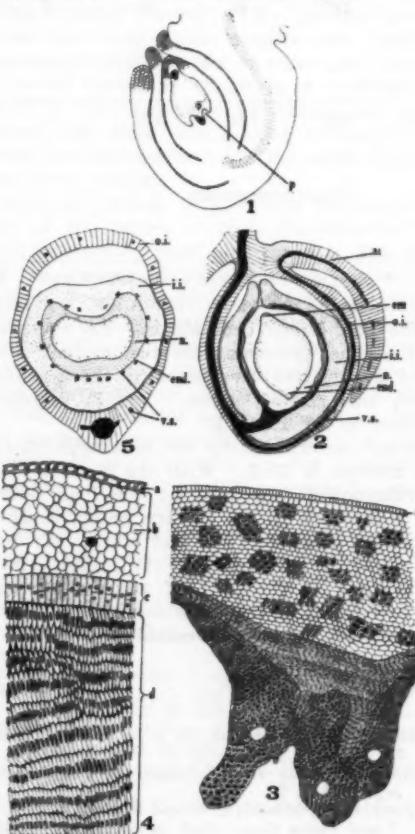


FIG. 1. I.s., ovule showing mature embryo sac and postament ($\times 30$). FIG. 2. I.s., seed at about the time the infoldings of the inner integument begin to appear, showing course of vascular bundles in the integuments and aril ($\times 8$). FIG. 3. I.s., inner integument after the infoldings are formed ($\times 30$). FIG. 4. I.s., outer seed-coat of mature seed ($\times 12$). FIG. 5. I.s., seed at about the same stage as in Fig. 2 showing arrangement of vascular bundles in the integuments ($\times 12$). a—epidermis; b—zone of parenchymatous cells; c—row of radially elongated cells; d—fibrous cells, ar.—aril, p.—postament, o.i.—outer integument; i.d.—inner integument; n.—nucellus; end.—endosperm; em.—embryo; v.s.—vascular strand.

Fertilization is porogamous. The pollen tube persists in the seed till a young embryo is formed. The endosperm is of the nuclear type. It becomes cellular in older stages of seed development. In the mature seed the endosperm completely replaces the nucellus. The zygote divides soon after fertilization and embryo development proceeds rapidly. The growth of the embryo in size is not in keeping with that of the seed. The mature dicotyledonous embryo which is very small, is imbedded in the massive endosperm.

As the seed enlarges, the inner integument grows in thickness and becomes many-layered. Even before cell-wall formation starts in the endosperm, the inner integument gives out infoldings from the sides into the nucellus. The cells of the inner integument are thin-walled and are filled with tannin (Fig. 3). It remains much the same in structure and thickness, and forms the inner seed-coat of the mature seed. The outer integument does not grow much in thickness till the seed is nearly mature. Its outer epidermis shows stomata. The cells of its inner epidermis have dense cytoplasm and prominent nuclei. They become radially elongated and look like palisade cells. As the seed reaches maturity, these cells, by repeated transverse divisions, give rise to 8-10 layers of radially elongated cells whose walls become sclerified and show simple pits. In the mature seed which is 1½-2" in length, the outer seed-coat, formed by the outer integument, is very hard and thick and consists of (Fig. 4), (1) the epidermis with cuticularised thick-walled cells, (2) a zone of 5-6 layers of parenchymatous cells, (3) a row of radially elongated cells with dense cytoplasm and nuclei, and (4) 6-8 layers of fibrous cells.

The ovular vascular bundle splits up into a number of strands which form a ring of bundles in the chalaza about the time the infoldings of the inner integument begin to appear. Some of these pass into the outer integument in which they reach up to the micropyle and thence into the aril (Fig. 2). The other vascular strands pass into the inner integument (Fig. 5) and traverse upto the micropyle (Fig. 2) giving out on their way a branch to each of the infoldings (Fig. 3). The presence of vascular bundles in the inner integument has been recently reported in *Ricinus communis* by Singh.²

The author is indebted to Prof. J. Venkateswarlu for suggesting the problem and for his helpful guidance and to Mr. K. Fazlullah Khan

and Mr. J. Samuel Sundara Raj, Coonoor, for supplying fixed material.

Dept. of Botany, R. L. N. SASTRI,
Andhra University,
Waltair, December 30, 1954.

1. Voigt, A., *Ann. jard. bot. Buitenzorg*, 1888, 7, 150.
2. Singh, R. P., *Phytomorphology*, 1954, 4, 118.

RATES OF INITIATION IN THE POLYMERISATION OF METHYL ACRYLATE

ONLY a few investigations¹⁻⁶ have been reported so far with regard to the mechanism of free radical polymerisation of methyl acrylate in liquid phase. Matheson *et al.* have evaluated the absolute rate constants for propagation, termination, etc. Nathan Fuhrman *et al.*⁷ and Jyothindranath Sen *et al.*⁸ have reported the values for the constants in the Staudinger equation, for the average degree of polymerisation for polymethyl acrylate. We are reporting here the general nature of polymerisation of methyl acrylate under various conditions and evaluation of rates of initiation (R_i') and chain transfer constants for the monomer (C_m) and catalyst (C) benzoyl peroxide. The polymerisation experiments were confined to a temperature range of 55-70° C. The results indicate the almost unitary nature of the catalyst efficiency, first order kinetics of the overall rate, bimolecular nature of the termination process, the order of initiation rates and chain lengths, the transfer of the growing polymer chain with the catalyst and the monomer.

Rate of initiation has been deduced from the product of square of the slope (KM) of the plot (Fig. 1, A, B, c and d), overall rate against square root catalyst concentration and the slope ($A'/M^2 = A$) of the plot, (Fig. 1, A, B, c and d) reciprocal degree of polymerisation against overall rate. Further from the slope and intercept of the plot ($1/P_n - AR_p$) against $[Cat]/[M]$, (Fig. 2, E), the constants C_c and C_m have been evaluated. A and K are constants involving rate constants for termination and propagation.

It was found that carefully deaerated pure methyl acrylate monomer at 50-70° C. without any initiator gave often irreproducible results with induction periods for over 4 hours. Experiments in ethyl acetate solution did not eliminate the induction periods. With benzoyl peroxide (10^{-3} - 10^{-4} M) however pure methyl

acrylate gave rather high initial rates and an irregular variation of overall rate with

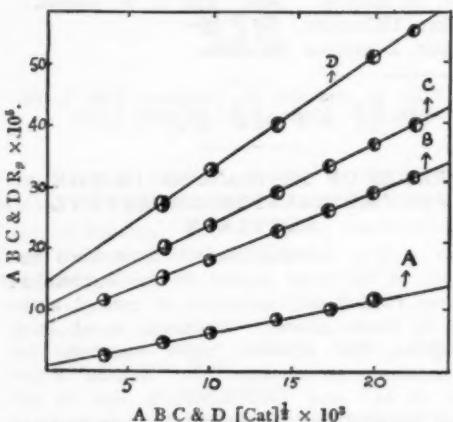
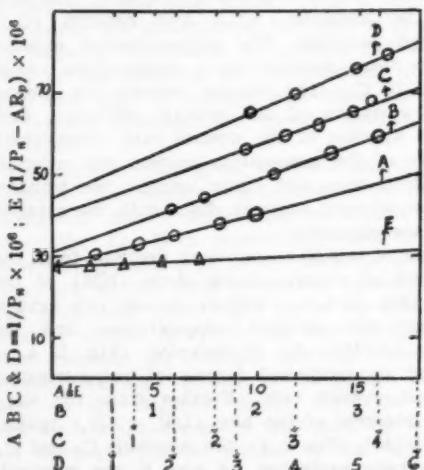


FIG. 1. Plot A represents the relationship between overall rate and square root catalyst concentration, in the polymerisation of methyl acrylate (50% solution in ethyl acetate) at 55°C., the time of the reaction being an hour and a half. Plots B, C and D represent similar relationships at 60°, 65° and 70°C., respectively.



$$A = R_p \times 10^5; B C \& D = R_p \times 10^4; E = [(\text{Cat}) / M] \times 10^5$$

FIG. 2. Plot A represents the relationship between reciprocal degree of polymerisation and overall rate in the polymerisation of methyl acrylate (50% Solution in ethyl acetate) at 55°C.

Plots B, C and D represent similar relationships at 60°, 65° and 70°C.

Plot E represents the relationship between $(1/P_n - AR_p)$ and $[\text{Cat}] / [M]$ at 55°C. in the polymerisation of methyl acrylate (50% solution in ethyl acetate).

(a) $[\text{Cat}]$, (b) reciprocal degree of polymerisation, though for the latter a regular variation was noticed if the initial rate was not very high. Ethyl acetate solution of methyl acrylate (50%) with benzoyl peroxide at 55–70°C. while eliminating induction periods gave also somewhat high initial rates. However, the first order kinetics for conversion of monomer has been observed.

At 55°, 60°, 66° and 70°C., the values obtained for K were 1.038×10^{-3} , 1.963×10^{-3} , 2.327×10^{-3} , 3.472×10^{-3} respectively and for A' the values were 3.68, 2.5, 2.14, 1.97 respectively. Values for rates of initiation were 7.94×10^{-6} , 1.94×10^{-5} , 2.32×10^{-5} and 4.8×10^{-5} respectively. The transfer constants for catalyst was of the order of 10^{-2} and for the monomer, 10^{-6} .

A comparison of overall rates for thermal and catalysed reactions together with a knowledge of the catalysed initiation rates gave for the thermal rate constants for initiation the values, 9.78×10^{-12} at 60°C. and 2.72×10^{-11} at 70°C. Further the calculated values of chain lengths for polymethyl acrylate prepared under catalysed conditions at 55, 60, 65 and 70°C. were 36210, 37310, 39870 and 26040 respectively. The corresponding experimentally determined values for average degree of polymerisation were 23530, 17700, 15380 and 13160. The fact that P_n values are very much less than chain length suggests predominance of termination by combination.

Experimental results with a full discussion will appear elsewhere.

Univ. Physical

M. SANTHAPPA.

Chem. Lab.,

V. MAHADEVA IYER.

Madras-25, March 16, 1955.

1. Staudinger, H. and Trommsdorff, *Liebigs Ann.*, 1943, 562, 201.
2. Walling, C., *J. Amer. Chem. Soc.*, 1948, 70, 2561.
3. Bagdasaryan, K. S., *J. Phys. Chem., Moscow*, 1948, 22, 1181.
4. Barnes, C. E., *J. Amer. Chem. Soc.*, 1945, 67, 217.
5. —, Elfson, R. M. and Jones, G. D., *Ibid.*, 1950, 72, 210.
6. Matheson, M. S., Bevilacqua, E. Auer E. E. and Hart, E. J., *Ibid.*, 1951, 73, 5395.
7. Nathan, Fuhrman and Robert, B. Mesrobian, *Ibid.*, 1954, 76, 3281.
8. Jyothindranath Sen, Sathy Ranjan Bannerjee and Santi, R. Palit., *J. Sci. Ind. Res. (India)*, 1952, 11B, 90.

REVIEWS

Electronic Measuring Instruments. By E. H. W. Banner. (Chapman & Hall), 1954. Pp. xiv + 395. Price 45 sh.

Electronic instruments nowadays find increasing applications in different fields of measurement, because they are more flexible for a given sensitivity. Further, another important advantage is the possibility of automatic control.

The book under review deals with various types of modern electronic instruments. The first part of the book discusses the indicating meters which record the readings ultimately on a panel. This is followed by a few chapters on what may be called the 'input' stage, like valves, photocells, radiations and particle detectors which convert the entity to be measured into electrical quantities. The third part deals with the complete set-up, like valve meters, cathode ray instruments, photoelectric devices and nuclear techniques such as radioactive assay instruments and the β thickness gauge. The last part of the book is devoted to electronic counters and quasi-electronic instruments like transducers and thermistors. A considerable portion of the book is contributed by specialists in the field like D. Taylor (radiation instruments), J. H. Reyner (cathode ray tubes) and the late R. C. Walker (photoelectric devices).

Granting the authors' choice of the instruments, one finds a lack of balance in the discussion of some topics. D.C. amplification, for instance, is treated at a very elementary level; contact potential is hardly indicated. Although this subject finds application in many instruments, the limits of sensitivity, as set by these factors, are not discussed. The section on cathode ray tubes and instruments may suffice only to understand the panel controls while under photo-electric devices, one finds, in some of the complete instruments, that the photocell is only a minor accessory, insignificant in comparison with the functions of the elaborate optical arrangement.

Minor blemishes are also found frequently. Particularly, one notices a lack of correspondence between symbols in text and those on diagrams. An extreme instance of this type is Fig. 9/1 where three of the four symbols are put wrongly. Again in Fig. 11/10 (a), the main amplifier is A.C. and not D.C. The

circuit diagram of the triggered pulse generator (Fig. 2/8) is not correct. In the schematic diagram of counting system (Fig. 11/11) the high voltage may be more properly shown as applied to the detector rather than the pre-amplifier.

Modern electronics is not confined to the communication of signals as in the radio, television and radar. It has a much wider field of application, particularly in physical measurements. This book clearly indicates this growing trend and is a good general introduction to the subject.

K. S. CHANDRASEKARAN.

Automatic Protection of A.C. Circuits. Fourth Edition. By G. W. Stubbings. Revised and Edited by C. M. Dobson. (Chapman & Hall, London), Pp. 355. Price 50 sh.

In this fourth edition of the well-known publication, the chapters dealing with relays and protection systems have been completely revised and re-edited. The glossary of protective gear engineering terms has been re-edited. A new chapter dealing with the earthing of power systems neutral has been included. To enable students and engineers to appreciate present-day British practice in protective gear, information has been included regarding the selection and performance of protective gear normally provided on modern electrical equipments.

The first chapter deals with a historical survey of different steps in the development of automatic protective gear and discusses the advantages and limitations of the different systems. The next two chapters deal with the use of protective transformers, the different errors and their measurement, performance of current and potential transformers with special reference to the British Standards Specifications for such transformers. Detailed discussion is given of different methods of interconnection of transformers to obtain resultant currents or voltage corresponding to the vector addition or subtraction of the corresponding primary circuit currents or voltages. A general indication of the effect of errors of transformers on the results of the interconnection as also the effect of relay impedance on primary operating current are included.

A chapter is devoted to the theory of sym-

metrical components as a background to the understanding of classes of network in protective systems. Conditions which give rise to negative and zero sequence components are discussed and methods of calculations of fault currents are indicated. Various types of relays and their classification according to different characteristics are described in a chapter on protective relays.

The chapter on neutral earthing deals with the comparison of isolated neutral and solid earthing systems and discusses the different systems of earthing through impedance and their application to meet the different requirements in power systems. The next two chapters deal with modern methods of protection of electrical machinery, busbars, feeders and transmission line. The present-day needs of protection of unit-operated generators and transformers are fully discussed. The development of modern high speed protection and carrier current protection for long transmission lines are also included.

The last chapter is devoted to the testing and maintenance of protective gear. It is rightly pointed out that the testing of protective gear comprehends not only that of the instrument transformers and relays which are the component parts of the gear, but also the checking of the correctness of the assembly of these components and their connections to form a protective circuit.

The bibliography includes reference to the English publications in journals and books related to the subject. Some references to Continental and American publications would have been helpful.

C. S. GHOSH.

The Testing of High Speed Internal Combustion Engines. By Arthur W. Judge. (Chapman & Hall, Ltd., London), 1955. Pp. xvi + 494. Price 75 sh.

This well-known book has been published in its fourth edition which has been revised and enlarged considerably taking into account new measuring methods and instruments. It has thus become a text-book on the testing of Internal Combustion Engines covering this wide and varied field in its major aspects.

The text is divided into fourteen chapters, the first two covering the general principles, mainly of the Otto petrol engine and its performance, and the test procedure adopted for ascertaining its output. The next two chapters review the details of measuring techniques adopted for metering the charge, i.e., for the

fuel and the exhaust gases (Chapter III), and for the air supply (Chapter IV). The cooling water system of test set-ups is considered next. The central portion of the book is devoted to the measurement of the output (Chapter VI) which is followed by a detailed treatment on pressure measurements and the types of indicators used (Chapters VII and VIII), with two more chapters devoted to cathode ray indicators and a discussion on indicator diagrams and their evaluation. A chapter on temperature measurements concludes this more specific portion of the book, which is followed by three chapters outlining particular items involved in the testing of Diesel engines, reciprocating aero engines and mainly aero gas turbines. The book concludes with a chapter on some special instruments and measuring methods applied in more serious work, say, for research and development, and a number of appendices dealing with test data evaluation, the international standard atmosphere, the SAE aircraft engine test code, and finally the calculations of the air-flow passing through standard throttle plates. The index allows quick reference especially in combination with the detailed list of contents.

The book conveys excellently the present state of instrumentation and measuring techniques adopted in this important field of mechanical engineering with its often complex and unusual features such as high pressures and extremely high temperatures sustained only for fractions of a second, and high speeds and accelerations. Considering the extent of the subject, it is understandable that mention could be made only of the most outstanding contributions, but work undertaken on the Continent has found but little attention. A few further suggestions are: operational data are given for the petrol engine (Chapter I) but hardly for the Diesel engine, and Chapter II on test procedure contains subjects which are repeated later in greater detail. The new chapter on testing of complete gas turbines and their components and accessories is rather general, and the information contained in the last chapter could be inserted earlier where similar instruments are considered. Many readers may be interested to have more exhaustive information on standard test codes of stationary or of automotive engines rather than aero engine testing, and, incidentally, may also wish for more references (e.g., on page 19) and information on suppliers (e.g., on page 229). Some small inaccuracies could be remedied in the next edition such as on

No
May
page
on p
ever,
value
seriou

Study
Re
Pro
the
Wh
towa
6%,
coal
coals
and I
now
of Ma
establis
State
indust
Plan,
coal v
The p
on M
need.

The
embod
investi
collect
The
and t
of ove
this s
coals
on the
Institu
The
classifi
with p
the N
Classifi
the ba
ing to
tile In
chapt
indica
ples, a
method
mixtur
the su
industr
of met
purpos

This
commen

page 65, and in Fig. 4 on page 12, and Fig. 104 on page 146. These shortcomings do not, however, detract or diminish in any way the unique value of the book for the student and the serious worker in this fascinating subject.

H. A. HAVEMANN.

Study of Madhya Pradesh Coals with Special Reference to Their Beneficiation and Caking Properties. By S. B. Pandya. (Published by the Nagpur University.) Pp. 108. Price Rs. 4.

While the contribution of Madhya Pradesh towards India's output of coal is just about 6%, that State holds nearly 30% of our total coal resources. The superiority of the coking coals obtainable from the collieries of Bihar and Bengal for metallurgical purposes has till now stood in the way of a proper exploitation of Madhya Pradesh coal reserves. But with the establishment of the new steel factory in the State and with the further programme of industrialisation envisaged in the Five-Year Plan, it may be expected that Madhya Pradesh coal will come into its own in the near future. The publication of a monograph of this type on M.P. coals is therefore meets a timely need.

The earlier chapters in the monograph embody the methods and results of systematic investigation on a large variety of coal samples collected from different localities in the State. The proximate analysis of some 107 samples and the calorific values and sulphur contents of over 50 of these samples are tabulated in this section. A scheme of grading of M.P. coals has been developed, which though based on the scheme proposed by the Fuel Research Institute, is claimed to be more systematic. The best coals according to this grading—classified as 'Selected Grades A and B' and with price points in the range 75-81—come from the North Chhattisgarh fields or Korba area. Classification of coals has also been done on the basis of their 'rank' or maturity, according to Parr's classification and Specific Volatile Index Classification Schemes. The later chapters include determination of the caking indices of raw, beneficiated and blended samples, and washability tests by float-and-sink method using benzene-carbon tetrachloride mixtures. Conclusions have been drawn on the suitability of different coal samples for industrial utilization such as the manufacture of metallurgical coke, soft coke for domestic purposes, and of coke briquettes.

This useful and informative monograph will commend itself to all engaged in coal research,

and especially to those interested in developing Madhya Pradesh coal.

A. P. MADHAVAN NAIR.

Nutrition Research Laboratories—Annual Report for 1953-54. (Indian Council of Medical Research.) Pp. 27.

This booklet contains a report of the research work carried out at the Nutrition Research Laboratories, Coonoor, during 1953-54. As in previous reports, details of research work have been given of studies on vitamins, proteins, clinical investigations, pathology and field work, together with the titles of eighteen research papers published in India and abroad. It is stated that by the usual cooking procedures adopted in India, the losses in vitamin A varied between 10 and 47%, and not very much more as assumed by earlier workers. In regard to the mode of action of vitamin D, the conclusions drawn from the results so far obtained are interesting, but need confirmation, preferably by use of radioactive phosphorus and C¹⁴ labelled pyruvic and citric acids. A detailed study has also been made on body composition and basal metabolism, and the nutritional disease, "Kwashiorkar", has been further investigated. As regards studies on liver injury, the ideas put forward in lines 3 and 17 on p. 21 appear conflicting. In view of the recent reports on the biochemical importance of trace elements like molybdenum, parallel studies can profitably be carried out on some trace elements, particularly in experimental investigations of liver injury in rats. There is, however, no denying the fact that some very useful results have been obtained by the research group in Coonoor in both the fields of experimental and clinical nutrition, and one can look forward with confidence to more significant contributions in the future. P. S. SARMA.

Semi-Micro Organic Preparations. By J. H. Wilkinson. (Oliver and Boyd, 98, Great Russell Street W. 1, London), Pp. x + 94. Price 8 sh. 6 d.

The above book describes a number of organic preparations involving the use of small-scale apparatus and semi-micro techniques. The advantages of the adoption of semi-micro techniques in preparative work are not so well recognised as in quantitative work, and the present work is meant to provide training in such techniques for beginners. The preparations included are varied in character and illustrate the different techniques employed.

A few errors are present which, it is hoped, will be eliminated in subsequent editions of the book. The inaccurate stoichiometric equation on p. 28 for oxidation of ethanol to acetic acid, the misleading statement on p. 82 that 'dimedone is.....a reagent for the preparation of aldehydes', and the description on p. 68 of the group NH-AC as acetylmino are errors which need to be corrected. Furthermore, a desirable improvement would be to state the standard yield obtained for each preparation, so that the student can evaluate his own technique.

These are only by the way, and the book will no doubt be found useful by students and teachers alike of preparative organic chemistry.

S. SWAMINATHAN.

The Plant Quarantine Problem. By W. A. McCubbin. (Ejnær Munksgaard, Copenhagen.) Pp. 255. Price 34 sh. 6 d.

The author, who has a long experience of plant quarantine work in the U.S.A., has expounded in lucid style the principles and problems of plant quarantine. Although the literature of this subject is available from widely scattered sources, it is often concerned with particular phases of plant quarantine and no one has yet undertaken to present the subject as a composite whole, bringing together all its aspects in such a form as to constitute an overall review. The author in his present book has admirably succeeded in doing so.

The subject-matter of the book has been discussed in eight chapters: Introduction, The Biological Background, Social and Economic Relations, Legal Features, Administrative Aspect, Current Quarantine Problems Examined, Appraisal and Outlook and World Situation. There is an Appendix entitled 'The Historical Summary of Federal Plant Disease Quarantines'. The view-points presented in the book are mainly with reference to quarantine problems of the U.S.A., but the general considerations and conclusions would be of equal interest to other countries.

Plant quarantine is essentially a national undertaking and its effects are far-reaching on the agricultural economy of a country. Numerous examples of widespread destruction in the U.S.A. caused by introduced pests have been cited, much of which could have been prevented by timely action. There is a growing awareness in many countries of the benefits of plant quarantine. Although the book does not mention the efforts made towards international co-operation by the F.A.O. in 1951 in plant quarantine work and in the

establishment of Regional Plant Protection Conventions, the publication of this book by Dr. McCubbin will doubtlessly stimulate wider interest in the subject. P. R. MEHTA.

Tissue Culture Technique in Pharmacology. By C. M. Pomerat and 49 other authors. (*Annals of the New York Academy of Sciences*), Vol. 58, Art. 7, pp. -356. Price \$ 4.50.

This symposium on "Tissue Culture Technique in Pharmacology" is of great interest not only to the pharmacologist but also to the virologist, the histopathologist and the clinician.

Tissue culture technique, an innovation introduced by Harrison in 1907, has opened up a fertile field for investigating the action of drugs on various types of cells (single cells, mass cultures, and organ cultures; normal and malignant cells, etc.), under varying conditions. Not only do we learn something new about drug action but of greater importance, we are given an inner glimpse of the function of subcellular structures in living cells. The value of tissue culture to the study of viruses and antibody formation is immense.

The utility of tissue culture technique in pharmacology, its advantages and limitations are revealed in this symposium. The effects of drugs on cell division, growth and intracellular morphological changes, metabolism and motility are studied yielding valuable information. The isolation, management, stability and use of strains of various normal and malignant cells are described, promoting better understanding of the biology of many diseases and growth processes at cellular level. The symposium is replete with data concerning the types of cells chosen for culture, culture media and their modifications, adaptation of apparatuses, etc., of immense value to the virologist and the cytologist. Adaptation of tissue culture technique for the production and assay of viruses and their antibodies is envisaged. A number of papers are devoted to the use of tissue culture technique for the screening of drugs as to their tissue toxicity, anti-neoplastic activity, cell-sensitivity, etc. The reasons for the failure of antibiotic therapy in certain infections are investigated by studying the actions of chemotherapeutic and antibiotic agents on intracellular bacteria. The symposium also contains a number of descriptive and elucidative photomicrographs and time-lapse phase-contrast cine-photomicrographs.

M. N. GURUSWAMI.

SPANISH WHEATS*

THIS is a most interesting book dealing with a difficult subject in a masterly way. The aim of the author may be gauged from a few paragraphs from the Introduction. "Wheat in Spain has always been the most widely cultivated plant and of the greatest economic importance. The varieties of Spanish wheat go into the hundreds as a result of the special geographical position of the Spanish Peninsula, of the many peoples that in the course of centuries have passed through it, of the isolation imposed on various agricultural zones by the complicated mountain chains. The Spanish Peninsula is therefore a veritable genetical treasure-house of incalculable value. Unfortunately in recent times there has started a gradual loss of native wheat forms, induced by such causes as the greater facility of communications, the interchange of seeds, the abundant seed distribution carried out by official bodies, etc...."

The author has spent years in collecting every possible type of wheat from every corner of Spain; his aim was not only to satisfy the curiosity of a botanist, but also to search for genetical material for the improvement of the wheat crops in the country.

The book consists of twelve chapters. Chapter I gives a very detailed description of all the parts of the wheat plant that are usually taken into consideration in the systematic classification of the genus. Chapter II gives an artificial key of all the species cultivated in Spain; the key is based on that of Flaksberger. Chapters III-X deal with the following species of wheat in Spain: *T. vulgare* Host., *Compactum* Host., *Durum* Desf., *Turgidum* L., *Polonicum* L., *Dicoccum* Schübl., *Monococcum* L., *Spelta* L.

To give an idea of the treatment of these various species, we may take Chapter III for detailed notice. It deals with *Triticum vulgare* Host. The author follows Vavilov in splitting the species into two groups, *ligulatum* and *eligulatum*; each of these groups is again divided into sub-groups: *Muticum* Alef., *Aristatum* Alef., *Breviaristatum* Alef. and *Inflatum* Flaks.; there then follows a key to the varieties under each of these sub-groups. From p. 39 onwards the author deals with the races of Spanish wheats under each of the varieties mentioned by Flaksberger. After an artificial key for the variety, the following points are given for each of the races: common local name, locality where the race grows, general characters, leaves, culms, ears,

glumes, grain, field characters such as resistance to fungal pests, time from anthesis to ripening, short note on qualities for the preparation of bread.

Chapter XI is a summary of the details discussed in the previous eight chapters, giving the "geographical distribution of wheat varieties and races by regions and provinces"; it is a list where against the various provinces of the country are given the common or vernacular names and the equivalent scientific species and variety names.

Of the 80 plates in the book, two show the harvesting of wheat, and are of little interest; the rest show ears of wheat with some close-up photos to show details of the glumes, etc. Botanically the plates are very interesting and clear, and artistically they are a model of the photographer's art. The printing is neat and the whole book is a pleasure to the eye.

A few points on the negative side may also be mentioned. The scientific names are usually separated by a comma from those of the authors, a practice that is not recommended by the International Code of Botanical Nomenclature, though it was the general practice a few years ago. In the text occasionally specific names are capitalized (e.g., on page 25), and the author's name is given in what appears to be Spanish (e.g., on page 25, "*Triticum Polonicum*, Linneo"). In the Bibliography there are a few misspellings of foreign words. In a book of this sort, one would have expected greater attention paid to the genetical constitution of the species and varieties; the chromosome constituents of the various species are given on page 25, the chromosome number being the basis of the classification of wheat species, but there is no further mention in the book of the chromosome details of any of the varieties or races studied.

In spite of these slight blemishes the book is recommended as a model of typographic and scientific ingenuity; it is certainly an improvement on G. Evans "Varieties of Wheat grown in the Central Provinces and Berar" (1908), and on Howard and Khan "The Wheats of Bihar and Orissa" (1922).

Botanical Survey of India, H. SANTAPAU,
Calcutta.

* *Trigos Espanoles (Spanish Wheats)*. By Manuel Gadea (in Spanish). Published by the National Institute for Agricultural Research, Madrid, 1954, pp. xv + 453, price not given.

NUTRITIONAL FACTORS AND LIVER DISEASES*

THIS symposium is an outstanding contribution to our knowledge and understanding of recent work on nutritional liver diseases. Experimental work in laboratory animals has established the conception that certain specific food materials are essential for the well-being of the liver parenchyma and that deficiency of these nutriments can produce damage to the liver as serious as any noxious substance. This has opened out new ground as yet unexplored in our interpretation and understanding of various obscure liver diseases which are now proved to be nutritional in origin. During recent years there has been a phenomenal increase of research in this direction in many laboratories especially in America and Europe and a remarkable array of facts has been brought to light. Time is ripe that these isolated pieces of knowledge should be put together into a complete picture and this is what the symposium has tried to do with conspicuous success. In a collection of carefully selected papers, it brings together the findings of various important workers in this field of scientific research scattered all over the world. An opportunity is thus afforded to compare and correlate the observations and conclusions of experimental work on laboratory animals with several obscure liver diseases prevalent

in human beings especially in Asia and Africa.

Animal experiments have clearly shown that two distinct types of hepatic lesions are produced by deficient diets. In one case, there is a disturbance in the transport and utilisation of fat resulting in an intense fatty infiltration of the liver cells which, when long continued, develop a progressive diffuse fibrosis resembling Laennec's Cirrhosis. The other hepatic lesion brought about by deficient diet in experimental animals is massive necrosis, which either ends fatally or tends to heal with resultant scarring and nodular hyperplasia. Following these two separate disease entities of nutritional origin the symposium is divided into two main parts—one being devoted to fatty liver and cirrhotic diseases and the other to necrotic liver injuries.

Taking conditions in India, there is growing evidence to show that the fatty cirrhosis of the liver common in South India is a deficiency disease, closely similar in development to the pattern seen in experimental animals. But the specific type of cirrhosis seen in infants (infantile cirrhosis) common in several parts of India does not fit into any of the deficiency groups. Its cause and pathogenesis still remains vague and obscure.

This symposium is a valuable addition to our knowledge of liver diseases. It is bound to be of immense value to every worker in this field—clinician, pathologist or biochemist.

G. D. VELIATH.

* By Klaus Schwarz and 58 other Scientists. *Annals of the New York Academy of Sciences*, Volume 57, Art. 6, pages 615-962, Price \$ 4.50.

DR. D. M. BOSE

DR. D. M. BOSE, Director, Bose Institute, was felicitated on the occasion of his seventieth birth anniversary by his admirers, colleagues, pupils and friends at an impressive ceremony held on March 6, 1955, at Bose Institute, Calcutta. Many distinguished citizens of Calcutta including educationists, scientists and others attended the function and messages from eminent scientists and men of public affairs from all parts of the country recalling the contribution of Dr. Bose to the progress of science in India and extending for nearly half a century, were read out.

Dr. H. C. Mookherjee, Governor of West

Bengal, was the Chief Guest on the occasion and he along with Prof. M. N. Saha, Director, Institute of Nuclear Physics, and Prof. S. K. Mitra, Director, Institute of Radiophysics and Electronics, Calcutta, recounted the distinguished scientist's valuable contribution to the progress of science and scientific education in the country.

A special volume of the *Transactions of the Bose Research Institute*, containing a collection of papers contributed by 20 eminent scientists of India and abroad was dedicated to Dr. Bose on this occasion.

No.
May
Books

The
Vol.
son
Pric
Memor
No.
Oest
stein
vers

Molec
and
Brig
Cros
Pric
Theore
Vol.
lishi

New
A r
the m
netic
recent
Calif,
n-m-r
Vari
fixed
readily
field
simple
width
of cyl
caps a
terns.
this n
high a

'Runa

A r
to get
States
Resear
All th
"burni
so tha
The

Books Received

The Nucleic Acids—Chemistry and Biology, Vol. I. By Erwin Chargaff and J. N. Davidson (Academic Press), 1955. Pp. xi + 692. Price \$16.80.

Memoirs of the Society for Endocrinology. No. 3. *The Technique and Significance of Oestrogen Determinations*. Edited by P. Eckstein and S. Zuckerman. (Cambridge University Press), 1955. Pp. 96. Price 18 sh.

Molecular Vibrations—The Theory of Infra-Red and Raman Vibrational Spectra. By E. Bright Wilson Jr., J. C. Decius and Paul C. Cross. (McGraw-Hill), 1955. Pp. xi + 388. Price \$8.50.

Theoretical Principles of Organic Chemistry, Vol. I. By Walter Hückel. (Elsevier Publishing Co.), Pp. xi + 904. Price 77 sh. 6 d.

X-Ray Diffraction by Polycrystalline Materials. Edited by H. S. Peiser, H. P. Rooksby and A. J. C. Wilson. (The Institute of Physics, London, S.W.-1), 1955. Pp. 725. Price 63 sh.

A Laboratory Manual of Qualitative Organic Analysis, Third Edition. By H. T. Openshaw. (Cambridge University Press), 1955. Pp. xii + 92. Price 10 sh. 6 d.

Modern Gas Analysis. By P. W. Mullen. (Interscience Publishers, Inc.), 1955. Pp. ix + 354. Price \$5.50.

Higher Polymers—Emulsion Polymerization, Vol. IX. By Frank A. Bovey, I. M. Kolthoff, Avrom I. Medalia and Edward J. Meehan. (Interscience Publishers, Inc.), 1955. Pp. xii + 445. Price \$12.50.

Methods of Biochemical Analysis, Vol. II. Edited by David Glick. (Interscience Publishers, Inc.), 1955. Pp. vi + 470. Price \$9.50.

SCIENCE NOTES AND NEWS

New Laboratory Electromagnet

A new laboratory electromagnet embodying the most convenient features for varying magnetic field configurations was announced recently by Varian Associates, Palo Alto, Calif., manufacturers of klystron tubes and *n-m-r* spectrometers.

Varian's new magnet, the V-4004, has two fixed energizing coils with adjustable poles and readily changeable pole caps. A wide range of field contours can be set with ease. By a simple adjustment of each pole, any air-gap width up to 4·3" can be achieved. A variety of cylindrical, conical or specially-shaped pole caps are available for wide choice of flux patterns. Despite the comparatively small size of this new magnet, a gap field flux density as high as 28,600 gauss can be attained.

'Runaway' Nuclear Reactor

A nuclear reactor was deliberately allowed to get out of control recently at the United States Atomic Energy Commission's Reactor Research and Development Station in Idaho. All the safety control rods which maintain the "burning" of the atomic fuel were withdrawn so that the reactor could burn itself out.

The results proved far less disastrous than

might have been expected, since after an initial period of "running away" in which rapidly increased fission and the generation of excessive quantities of heat occurred, the reaction slowed down and then stopped. The reactor had in fact proved self-controlling, the rapid increase in fission having created conditions under which the reaction necessary for the continued "burning" of the atomic fuel could not be maintained. It would appear that a large number of the nuclear reactors so far constructed are of the self-controlling type, but other types of reactors, such as those using fast neutrons which are capable of breeding more atomic fuel than they burn up do not come in this category.

Taste, Smell and Molecular Weight

In the course of an article on the above subject in *Chemical Products* (1955, 18, p. 131), R. W. Moncrieff has shown that there is a well-marked relationship between molecular weight and taste which is shown in the appearance of a bitter taste with increasing molecular weight, irrespective of whether the taste of lighter members of the series is sour, salt or sweet. Although not without exceptions, this rule is of very wide application indeed.

Very high molecular weights usually result in insolubility in water, and as a result in tastelessness.

There is not such a relation in the case of smell, no tendency for a particular quality of smell to develop with increasing molecular weight. Eventually, when molecular weight rises so high that volatility is lost, smell falls away too. Low molecular weight is accompanied by more rapid diffusion, which will enable a smell to be perceived more quickly. A preliminary investigation shows that substances that have musky smells have molecular weights that are fairly closely grouped. If adsorption of odorant on olfactory receptor is the process that initiates the sensation of smell, molecular weight might be a factor in olfactory discrimination.

Tetracycline

Tetracycline, also known as polycycline and bristacycline, has shown itself effective in eradicating the diverse bacteria responsible for acne and other troublesome types of skin disease.

According to Dr. Charles R. Rein and his co-workers, bristacycline brought forth a speedy response in all of a group of 106 patients, the majority of whom were suffering from common acne. In more than half the cases, the improvement was "moderate to marked" during the first week of treatment, and the new drug is well tolerated by patients. Adverse reactions appear to be less frequent and less severe than with previously employed broad spectrum antibiotics. The successful use of the drug for a variety of other infections was also reported before the Second Annual Symposium on Antibiotics recently held in Washington.

Treatment of Rheumatic Fever

The results of a remarkable international trial of the relative values of cortisone, "A.C.T.H.", and aspirin in the treatment of acute rheumatic fever in childhood are given in the March 5, 1955 issue of the *British Medical Journal*.

Essentially there was no difference between the effects of the three, which tends to confirm a previous report on the relative value of cortisone and aspirin in rheumatoid arthritis

when, according to the criteria used, there was little to choose between them.

In the test described six centres in the United Kingdom were used, five in the United States, and one in Canada. The criteria for diagnosis and for measuring progress were drawn up in great detail and nearly 500 patients under the age of 16 received the special treatment in the special way it was planned. The choice of drug was determined by the opening of a sealed envelope, so that there was no bias.

The hormone treatment (cortisone and "A.C.T.H.") appeared to produce more rapid control in certain acute manifestations, but this was offset by a greater tendency for relapses at the end of treatment. After a year there was no essential difference in the state of the heart in the three groups.

Post-Doctorate Fellowship Awards to Indian Scientists

The following Indian scientists have been awarded the National Research Council of Canada's Post-Doctorate Fellowships for 1955-56:

J. Datta, Indian Institute of Science, Bangalore; I. Hussain, Muslim University, Aligarh; G. Kartha, University of Madras, Madras; M. L. Lakhanpal, Punjab University, Punjab; J. Sharma, Indian Institute of Technology, Kharagpur; G. Singh, N.P.L., New Delhi; A. G. Datta, Calcutta-19; M. L. Gattani, IARI, New Delhi; Rajinder Pal, Malaria Institute of India, Delhi; Vachaspati, Physical Research Laboratory, Ahmedabad; A. S. Atwal, Government Agricultural College, Ludhiana (Punjab).

Award of Research Degree

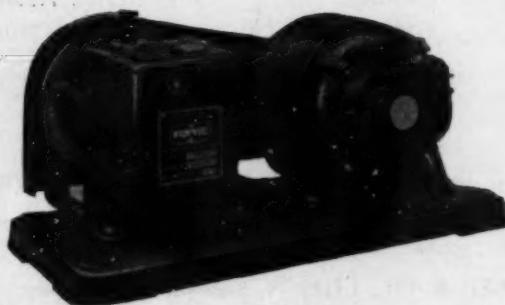
The University of Bombay has awarded the Ph.D. Degree in Chemistry to Shri G. Jagann Mohan for his thesis entitled "Biochemical Studies on the Flocculation of Sewage".

The University of Poona has awarded the Ph.D. Degree in Chemistry to Shri V. K. Phansalkar, for his thesis entitled "Dielectric Constant and Molecular Structure".

The Andhra University has awarded the D.Sc. Degree in Chemistry to Shri H. Sankey Gowda for his thesis entitled "Vanadometric Methods for the Assay of Pharmaceutical Preparations".

SUNVIC

ROTARY VACUUM PUMPS



Type SR. 2

Three types of rotary vacuum pumps are available for laboratory work—two single-stage and one direct drive two-stage

Also three types of Oil Diffusion Pumps

Write for illustrated Data Sheet to

the

Accredited Agents

MARTIN & HARRIS LIMITED

(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

WHATMAN

FILTER PAPERS

Filtration:

QUALITATIVE GRADES
QUANTITATIVE GRADES
HARDENED GRADES

Specialities:

ASHLESS TABLETS & FLOC
ANTIBIOTIC ASSAY DISCS
EXTRACTION THIMBLES

Cellulose Powder for

CHROMATOGRAPHY

Papers for

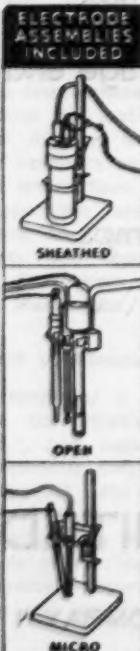
CHROMATOGRAPHY & ELECTROPHORESIS

ASK YOUR LABORATORY FURNISHER FOR FREE SAMPLES, OR
IN CASE OF DIFFICULTY WRITE SOLE MILL REPRESENTATIVES:

H. REEVE ANGEL & CO., LTD., 9, Bridewell Place, London E.C.4, ENGLAND

Made by:

W. & R. BALSTON LTD., MAIDSTONE, ENGLAND

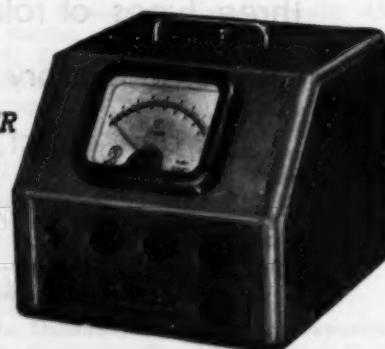


PYE UNIVERSAL pH METER AND MILLIVOLTmeter

This new version of the Pye pH Meter not only retains the many excellent features of the previous model such as low zero drift, stability under wide mains variations, ease of operation and automatic temperature compensation, but it now incorporates a manual temperature compensator, complete coverage 0-14 pH and a wide range of electrode assemblies.

In a wide variety of industries the Pye pH Meter is contributing towards higher productivity, the elimination of waste and improved product quality. An unskilled operator can test acidity or alkalinity of process solutions with rapidity and ease.

In laboratories covering a very wide range of research the Pye pH Meter is proving, by its convenience and consistently high accuracy, to be the outstanding instrument in its field.



Cat. No. C.4.11066

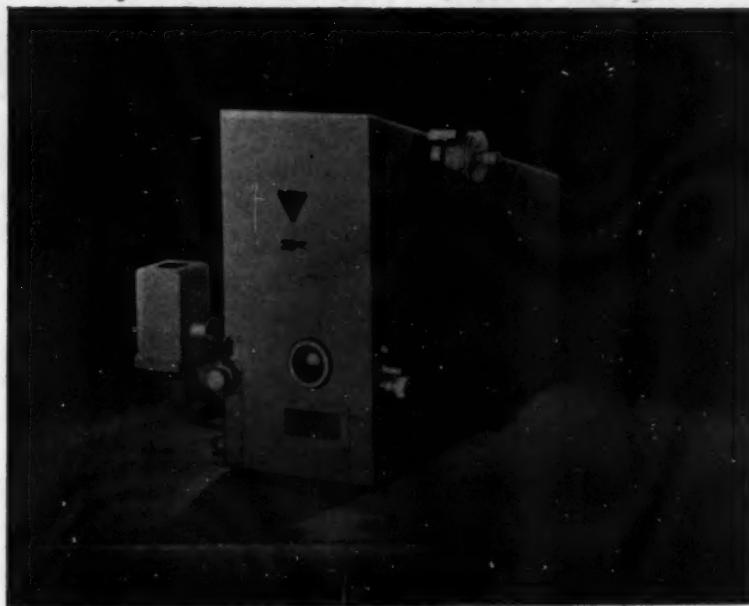
PORTABLE
MAINS OPERATED
DIRECT READING 0-14pH
RANGE OF ELECTRODE ASSEMBLIES
DRIVES CONTROLLERS
OR RECORDERS
MANUAL OR AUTOMATIC
TEMPERATURE COMPENSATION

SCIENTIFIC INSTRUMENTS

W. G. PYE & CO. LTD., GRANTA WORKS, CAMBRIDGE, ENGLAND

Bausch & Lomb

GRATING MONOCHROMATORS



Highest efficiency monochromatic light tailored to your exact wavelength need — U-V, VISIBLE, INFRA-RED. Select the equipment that meets your specific requirements . . . for monochromatic light of the highest spectral

purity and intensity. 250 mm. or 500 mm. Monochromators, with your choice of gratings for full range coverage (2000-14000 Å, first order) or more for intensive study in the ultra-violet or infra-red.

- Certified-Precision Gratings • High Dispersion
- Linear Wavelength Scale

Write for illustrated folder D-259 to

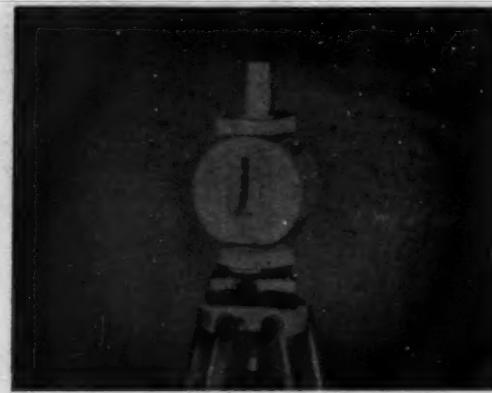
Sole Agents

MARTIN & HARRIS LTD.
(SCIENTIFIC DEPARTMENT)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1



ASKANIA MAGNETIC FIELD BALANCE



An essential tool for the Prospector, Mining Engineer and Geophysicist in regional work and detail surveys. Whatever may be the requirement, a speedy reconnaissance survey or a detailed magnetic investigation, the ASKANIA MAGNETIC FIELD BALANCE will be found a handy, easily operated instrument and the station cost will be lower than with any other approved geophysical method.

Sole Distributors:

**THE
SCIENTIFIC INSTRUMENT CO., LTD.**

CALCUTTA ALLAHABAD NEW DELHI MADRAS BOMBAY

